Economic Report of the EU Aquaculture sector (STECF-18-19)

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DOI:
10.2760/45076

Publication date:
2018

Document version
Publisher's PDF, also known as Version of record

European Commission

JRC SCIENCE FOR POLICY REPORT

Scientific, Technical and Economic Committee for Fisheries (STECF) - Economic Report of the EU Aquaculture sector (STECF-18-19)

Edited by Rasmus Nielsen, Natacha Carvalho & Jordi Guillen

Joint Research Centre

EUR 28359 EN

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JRC114801

EUR 28359 EN

PDF	ISBN 978-92-79-79402-5	ISSN 1831-9424	doi:10.2760/45076
STECF		ISSN 2467-0715	

Luxembourg: Publications Office of the European Union, 2018

How to cite: Scientific, Technical and Economic Committee for Fisheries (STECF) – Economic Report of the EU Aquaculture sector (STECF-18-19). Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-79402-5, doi:10.2760/45076, JRC114801

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EWG-18-19 report: Economic Report of the EU Aquaculture sector

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Abstract

Commission Decision of 25 February 2016 setting up a Scientific, Technical and Economic Committee for Fisheries, C(2016) 1084, OJ C 74, 26.2.2016, p. 4–10. The Commission may consult the group on any matter relating to marine and fisheries biology, fishing gear technology, fisheries economics, fisheries governance, ecosystem effects of fisheries, aquaculture or similar disciplines. This report evaluates the economic performance of the EU aquaculture industry during the period 2008-2016. Even if aquaculture production has been stagnant, the turnover and economic performance indicators have increased over time. The EU aquaculture sector reached 1.4 million tonnes in sales volume and €4.9 billion in sales value, in 2016.

SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF) - Economic Report of the EU Aquaculture sector (STECF-18-19)

Request to the STECF

The STECF is requested to review the report of the STECF Expert Working Group meeting, evaluate the findings and make any appropriate comments and recommendations.

STECF observations

Following the latest call for economic data on the EU aquaculture, EWG 18-19 was requested to analyse and comment on the economic performance of the EU and national aquaculture sectors between 2008 and 2016. The EWG met in Ispra, Italy, from 22-26 October 2018, and was attended by a group of aquaculture economic experts consisting of 27 experts from 19 countries and 3 JRC experts. In addition, 1 country provided advice on their national chapters by correspondence.

The 2018 Economic Report of the EU Aquaculture Sector is the sixth report of its kind, providing a comprehensive overview of the latest information available on the production, economic value, structure and competitive performance of the aquaculture sector at the national and EU level for the years 2008 to 2016.

Overall, the performance of the aquaculture sector is improving. The EU aquaculture sector reached 1.4 million tonnes in sales volume and €4.9 billion in sales value in 2016. This corresponds to an increase of 6% in sales volume and 8% in the sales value compared to 2014. The economic performance of the EU aquaculture sector has been improving on almost all economic indicators in 2016 compared to 2014 and 2015. This positive economic development is seen for all the three sub-segments: marine fishes, freshwater fishes and shellfish, which are all providing positive economic growth and generating positive profits.

This year a special effort was made to provide time trends for the data collection period 2008-2016. The totals and the time trends presented in chapter 2 of the report are based on the data collected under EUMAP. When data were missing, the EWG estimated plausible values based on EUROSTAT and FAO data. This enabled a comprehensive overview of the EU aquaculture sector.

This report includes two special chapters. Chapter 5 provides an assessment of the implementation of actions and measures for the promotion of aquaculture through a cooperation process based on multiannual strategic plans to be developed by the Member States. The EWG concluded that all EU countries have ongoing actions in one or all the strategic pillars, but only few countries have already overcome or are close to achieve the production goals stated in their Strategic Plans. In many cases the evolution in production can be better explained by factors outside the strategic plan actions, such as adverse environmental conditions. Furthermore, the projections included in the strategic plans might have been overoptimistic. In spite of this, the STECF supports the EWG’s view that the design and implementation of the Multiannual Strategic Plans for aquaculture sector is a step forward for the modern EU aquaculture and contributes to the coordination of the different stakeholders across countries towards a common goal and strategy.

Chapter 6 provides an overview of the consequences of the change in data collection over time, highlighting potential differences between previous and new EU Multi-Annual Programs (EU MAP). In principle, data submitted for the aquaculture data call is now based on data collected according to the national Working Plans for 2017, which should follow the new EU MAP regulation. STECF observes however that the continuity of data collected under old and new Commission Decisions is not aligned (the new EUMAP substantially changed the segmentation of the aquaculture sector and introduced a minimum threshold of production for data collection). Not all Member States used the same segmentation, and the minimum threshold implied that the fewer countries reported data, resulting in data gaps: 5 MS provided data in the format requested under EUMAP, 3 MS provided data in both formats, 3 MS did not deliver data due to the new threshold implemented under the EUMAP and 5 MS are land locked and hence not included in the DCF/EUMAP. 3MS did not report on their freshwater activities and 3 countries only reported part of their production, perhaps as a result of the newly introduced minimal threshold of production.

A special effort was thus made by the EWG to correct for the changes in data collection, in order to provide reliable time series and time trends from 2008 to 2016. Nevertheless, STECF observes that data gaps relates primarily to the freshwater sector for which reporting is not mandatory. STECF observes thus that this situation may result in a bias in the analysis of this sector and hence influence the conclusions on sector level characteristics.

Beside this, STECF notes that the overall quality of the data reported has remained stable over time.

STECF conclusions

STECF concludes that the report provides a good and reliable overview of the economic performance of the EU aquaculture sector. However, the reduction of MS reporting represents a deterioration in terms of data coverage compared to previous reports.

STECF concludes that taking into account time and resources available, the EWG analysis produced is of substantial standard, including actions to correct for differences in data formats and segmentation across Member States.

STECF concludes that in the future, the linkages across operational actions foreseen in Multiannual Strategic Plans for aquaculture, production goals and assessment indicators should be better aligned and specified.

In order to optimise the work of the EWG, STECF suggests that a scoping meeting is planned prior to the next data call for aquaculture. During this meeting the EWG chair, DG MARE and JRC can set a time schedule for the meeting and a deadline for data submission, prepare a division of tasks on data handling, can agree on reporting formats and evaluate the latest version of the report.

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REPORT TO THE STECF

EXPERT WORKING GROUP ON Economic Report of the EU Aquaculture sector (EWG-18-19)

Ispra, Italy, 22-26 October 2018

EXECUTIVE SUMMARY

The 2018 *Economic Report of the EU Aquaculture Sector* provides a comprehensive overview of the latest information available on the production, economic value, structure and competitive performance of the sector at the national as well as the EU level for the years 2008 to 2016. The current report replaces previous aquaculture reports.

In this report, a special effort has been made to present the development of the entire EU aquaculture sector from 2008 to 2016. The totals and the time trends presented in chapter 2 of this report are based on the data collected under DCF and EU-MAP, supplemented with EUROSTAT and FAO data, estimating missing values to be able to give a comprehensive overview of the EU aquaculture sector.

Overall, the performance of the aquaculture sector is improving. The EU aquaculture sector reached 1.4 million tonnes in sales volume and €4.9 billion in sales value, in 2016. This corresponds to an increase of 6% in sales volume and 8% in the sales value compared to 2014. The economic performance of the EU aquaculture sector has been improving on almost all economic indicators in 2016 compared to 2014 and 2015. This positive economic development is seen for all the three sub-segments; Marine fishes, freshwater fishes and shellfish, which are all providing positive economic growth and generating positive profits.

Additionally, a special chapter on the Multiannual National Strategic Plans is provided assessing to what extend measures and actions described therein have been or are being implemented. Furthermore, the experts tried to evaluate if the objectives for growth in the national plans was likely to be achieved by the ending of the current funding period 2020-2023.

Finally, the EWG compared variables reported under the DCF and the EU-MAP due to the fact that this data call covered both programs with different data requirements.

The EWG were able to adequately address all subject related to the TOR including a comparison of the reported variables under DCF and EU-MAP and writing a special chapter on the current status for the Multiannual National Strategic Plans concerning the implementation of action and measures and whether the objective for growth in the EU is likely to be achieved.

KEY FINDINGS

The EU aquaculture sector reached 1.4 million tonnes in sales volume and €4.9 billion in sales value, in 2016. This corresponds to an increase of 6% in sales volume and 8% in the sales value mostly due to increasing prices compared to 2014. The estimates of the production volume and value are based on data collected under the DCF and the EU-MAP complemented with Eurostat and FAO data to provide a full overview of the aquaculture sector for all EU28 MS. EU aquaculture production is mainly concentrated in 5 countries: Spain (21%), France (15%), Italy (14%), the United Kingdom (14%), and Greece (10%), making up 74% of the sales volume. These 5 countries are furthermore covering 73% of the sales value in EU28.

The total number of enterprises in EU is estimated to be 12 500. Almost 90% of the enterprises in the aquaculture sector are micro-enterprises, employing less than 10 employees.

The number of employees in EU was estimated to be 75 300 in 2016. This is a bit lower than earlier estimates number of employees that predicted a total number of employees in EU of around 80 thousand. The number of FTE was estimated to be 43 680, which might indicate a tendency towards higher specialization and less part-time employment in the sector, because the ration between employees and FTE has been decreasing. However, the use of part time labour still contributes significantly to the workforce in the European aquaculture sector. The average yearly wage was €25 000, corresponding to a 7% increase compared to 2014.

Profitability for the EU aquaculture sector was positive in 2016 and the Gross Value Added increased by 29% and EBIT increased with more than three times. The labour productivity increased by 20%. Furthermore, all other economic indicators also increased from 2014 to 2016.

The EU aquaculture sector can be divided into three main sectors: Marine, Shellfish and Freshwater production. The marine sector is the most important economically and generated the largest turnover of €2 731 million, followed by the shellfish sector with €1 134 million and the freshwater sector with €1 028 million.

The main species produced in terms of value are Atlantic salmon, rainbow trout and European seabass, whereas the unidentified mussels, which the experts believe to be Mediterranean mussels, dominate in weight.

In the marine sector, the United Kingdom is the main producer of salmon covering 91% of the value, while Greece is the main producer of seabream and seabass covering 47% of the value.

In the shellfish sector, France and Spain are the most important countries in terms of production volume and value, employment and numbers of enterprises. France is the main producer of oysters covering 86% of the total production, whereas Spain is the main producer of Mediterranean mussels covering 45% of the volume. The main producer of clam is Italy covering 80% of the production, however Portugal has the largest numbers of enterprises and Spain the largest number of employees in this sector.

The main species produced in freshwater is trout in terms of volume 69% and value 64%. The most important producers in terms of volume are Italy (19%), Denmark (17%) and France (14%). Carp is another important species mostly produced in Eastern Europe, where the main producer in volume are Poland (24%), Czech Republic (23%) and Hungary (14%).

The expert group evaluated the Multiannual National Strategic Plans assessing to what extend measures and actions described therein have been or are being implemented. In general, the perception of the experts was that the countries are implementing the measures and actions that are described in the National Strategic Plans. However, in most of the plans the growth objectives cannot be directly connected to the measures and actions implemented. Nevertheless, the experts found that the measures and actions to be beneficial to the aquaculture sector.

The expert group tried to evaluate if the objectives for growth in the national plans was likely to be achieved by the ending of the current funding period (2020-2023). Using the production in the base year 2013 as a starting point many countries seems to be on track concerning their production goals, however, whether this is just a catching up effect from the weak performance in the base year (especially for the shellfish production) or an actual improvement in the overall EU production is difficult to access.

All countries have ongoing actions in one or all the strategic pillars, but only few countries have already overcome or are close to achieve the production goals. In many of these cases the evolution in production can be better justified by causes outside the strategic plan actions, such as, adverse environmental conditions. Furthermore, the evolution in production when looking by main segments significantly differs from projections even in those countries that have grown more than expected. Overall, the projected quantities and values appear to be too optimistic or even unrealistic, which lead to the conclusion that the production goals will not be reached.

Despite of the above reserves, the design and implementation of the Multiannual Strategic Plans is a step forward in the lifetime of modern EU aquaculture and a success in coordination of the different stakeholders across countries towards a common goal and strategy.

The expert group was asked to compare the variables under the DCF and the EU-MAP and evaluate how time series disruption could be avoided comparing the variables requested under the two programs. It was found that the economic variables are comparable and that this will not cause any time series disruption. However, the shift in segmentation (production technique and species), will compromise the ability to make time series on the national as well as the EU level. An alignment of the data break for all EU Member States is suggested to minimize the time series disruption. Furthermore, a guide for data providers, experts and end users is suggested, to align the segmentation between the two programs and between EU Member States. This will improve the comparability and validity of the data collected and makes comparison at the segment level, between countries and at the EU level, more reliable.

1 INTRODUCTION

The 2018 *Economic Report of the EU Aquaculture Sector* is the sixth report of its kind produced for the sector and provides a comprehensive overview of the latest information available on the production, economic value, structure and competitive performance of the aquaculture sector at the national and EU level for the years 2008 to 2016.

Europe represents one of the largest markets for seafood products in the world and consumption has steadily increased over the past decades. Per capita consumption is estimated to be 24 kg, in 2016. EU is the fifth largest producer of fish and aquaculture products covering approximately 3% of the global production (5.6% for wild capture fisheries and 1.2% of aquaculture). On a global level production of seafood for human consumption are almost equally divided between aquaculture and fishery. However, the EU market is still dominated by products originating from fisheries covering around 80% of the available seafood products. EU's consumption of seafood products is mainly covered by import making up around 60% of the total supply. The EU is therefore highly dependent on imported seafood to the EU market (EUMOFA, 2018).

The future demand for fish is expected to increase due to increasing population and income and health benefits associated with fish consumption. The growing demand offers a unique opportunity to expand the aquaculture production in the EU. However, this also implies that the EU farmers continuously succeed in staying competitive on the global market for seafood products.

To increase EU own supply of seafood product aquaculture seems to be the most obvious choice since the supply from fisheries has been stagnating since the late 1990's. However, the EU aquaculture production has also been stagnating and growth in global production is currently dominated by Asian countries covering about 90% of the global production volume. In contrast, the EU contribution to world aquaculture production has been decreasing significantly over time in both volume and value terms, representing only 1.2% and 1.9% of global production in 2016 (FAO 2018).

A precondition to move the European aquaculture sector forward is to establish and increase the knowledge of the existing aquaculture production. In that respect, this report is an important contribution providing economic information on an overall EU level and furthermore providing a detailed description on the national level on production of main species produced and technique used in the sector.

This report responds to the requirements of the Terms of References (TOR), through the following structure. After the executive summary and key findings a short introduction is presented in Chapter 1. Chapter 2 provides an EU overview of the sector. Chapter 3 includes a detailed analyses of the aquaculture sectors (i.e. marine, shellfish and freshwater) and of the main species produced. Chapter 4 analyses the economic performance, structure and main species produced by each Member States as well as provides an outlook for future production trends.

This report includes two special chapters. Chapter 5 provides an assessment of the implementation of actions and measures descript in the Multiannual National Strategic Plans and their progress towards achieving the growth objectives within the National Strategic Plans. Chapter 6 provides an overview of the changeover from DCF to EU-MAP highlighting potential differences and correspondence between the two programs. The changes in definitions have impacts on the time series especially concerning the segmentation on different production techniques. The economic data collected under the two programs are listed in Annex I together with the new segmentation on species and technique.

This year a special effort has been made to provide time trends for the data collection period from 2008 to 2016 using estimated values when data has not been available under the DCF or EU-MAP. The results of this effort can be seen in the EU overview (chapter 2) and the method is further described in Annex V. On the other hand, while data for the reporting countries continue to improve, the EWG still encountered some data gaps. This relates primarily to the freshwater sector for which reporting is not mandatory, the newly implemented threshold and non-reporting countries. Details about data issues and how they have been addressed are explained in Annex III.

Only two countries provided environmental data on medicines and one country on mortalities. It has therefore been agreed with DG MARE that data on environment is not presented and analysed within this report. While social data is to be collected by MSs from 2018 according to the regulation, and therefore, to be submitted in the next data call for the EU aquaculture sector.

Finally, the report is completed with a Glossary (Annex II), and the list of EWG participants (section 7).

1.1 Terms of Reference for EWG-18-19

The report has been produced by a group of aquaculture economic experts convened under the Scientific, Technical and Economic Committee for Fisheries (STECF). The expert group consisted of 27 experts from 19 countries and 3 JRC experts. In addition, 1 country provided advice on their national chapters per correspondence.

Following the latest call for economic data on the EU aquaculture, EWG 18-19 is requested to analyse and comment on the economic performance of the EU and national aquaculture sectors between 2008 and 2016.

In 2018, the special chapter contains a description of the current status of the Multiannual National Strategic Plans for the development of sustainable aquaculture and expectations for obtaining the underlying growth objectives with the aim of evaluating two main objectives.

- To assess to which extent the measures and actions described in the Multiannual National Strategic Plans have been, or are being implemented.
- To assess the potential growth in the EU aquaculture sector and indicate whether the objectives for growth in the EU aquaculture are likely to be achieved by the end of the current funding period in 2023.

TERMS OF REFERENCE

STECF is requested to provide the Annual Economic Report on Aquaculture sector for 2016 including, at least, the following sections:

The STECF expert working group (EWG 18-19) is requested to provide the Economic Report of the Aquaculture sector for 2018 including the following sections:

<u>Background and general objectives</u>

Following the 2018 DCF call for economic data on the EU aquaculture sector, STECF EWG 18-19 is requested to analyze and comment on the economic performance of the EU and national aquaculture sectors between 2008 and 2016.

The aquaculture report is one of the main sources for providing socio-economic analysis on the performance of the EU aquaculture industry. It is also increasingly used by scientific bodies, national administrations and international institutions.

In view of the above, the EWG is requested to provide an in-depth examination of the different factors of the economic performance of the EU aquaculture industry and to highlight the underlying trends and drivers of its economic performance.

Given the social importance of this activity in many communities, particular emphasis should be paid to the social aspects of the analysis including trends in employment, salaries, labour productivity and female/male breakdown of the aquaculture employment. When possible, incorporating results from the pilot studies.

The main socio-economic indicators, if possible and where relevant, should also be put into context with homologous figures at the EU and national levels, e.g., national average salaries, GDP, etc.

The two main objectives for the 2018 exercise are to increase qualitative interpretation of all data outputs and to increase the usefulness of the report for DG MARE's policy development as well as for Member States and the industry.

The final draft EWG report will be reviewed by the STECF during its winter plenary meeting in 2018.

Specific objectives:

In preparing the 2018 report on the economic performance of the EU aquaculture sector, the STECF EWG 18-19 is requested to include the following:

A summary of key findings.

An overview of the economic performance of the EU aquaculture sector: including drivers and main trends. It must also include specific sections on employment (e.g. female/male employment and average salaries), economic performance contrasting different segments, and productivity/employee at EU level as well as a brief summary for each national chapter.

At EU level analyses of economic performance by aquaculture segments (marine, shellfish, freshwater) and species.

National chapters on the economic performance of the aquaculture segments:

- National aquaculture overview
- Production and sales
- Industry structure and employment
- Economic performance and indicators
- Structure and performance of aquaculture segments
- Trends and triggers, including Recent developments and Outlook for future trends
- Data coverage and quality

Comparison of the variables reported under the DCF and the EU-MAP, looking in particular at differences and correspondences between both sources to minimise time-series disruptions. Discuss presentation and analysis in the EWG report of EU-MAP environmental (i.e., medicines and mortalities) and social data.

As a matter of priority, the EWG is requested to ensure that all unresolved data transmission (DT) issues encountered prior to and during the EWG meeting are reported on line via the Data Transmission Monitoring Tool (DTMT) available at https://datacollection.jrc.ec.europa.eu/web/dcf/dtmt.

Guidance on precisely what should be inserted in the DTMT, log-on credentials and access rights will be provided separately by the STECF Secretariat focal point for the EWG.

Special topic:

The current status of the Multiannual National Strategic Plans for the development of sustainable aquaculture and expectations for obtaining the underlying growth objectives

Based on the Multiannual National Strategic Plans drawn up by Member States in accordance with Art. 34 of Reg. 1380/2013, the STECF is requested to assess the extent to which the measures/actions described therein have been, or are being implemented. The STECF is also requested to assess the potential growth in the EU aquaculture sector and based on such an analysis, indicate whether the objectives for growth in EU aquaculture are likely to be achieved by the end of the current funding period in 2023.

2 EU AQUACULTURE SECTOR OVERVIEW

Aquaculture is one of the fastest growing food producing sectors in the world and is an increasingly important contributor to global food supply and economic growth. The share of global supply of fish products for human consumption from aquaculture went from being 16% in 1990 to 54% in 2016 including aquatic plants. Excluding the 30 million tonnes of aquatic plants produced in aquaculture, the sector still makes up for 47% of the fish and shellfish produced worldwide. The total estimated global production from captured fisheries and aquaculture increased from 193 million tonnes in 2014 to 202 million tonnes in 2016. The increase was mainly driven by the aquaculture sector, which increased by 9%, while capture fisheries decreased by 0.4%. The production from world capture fisheries has been fluctuating around 90 million tonnes per year during the last two decades. In contrast, the global aquaculture production has been increasing, as shown in Figure 2.1.

The global value of aquaculture production reached €220 billion (243 billion USD) in 2016 (FAO, 2018). The sector has increased production more than 4 times since 1990 (see Figure 2.1). However, this growth has primarily been driven by Asian countries producing 92% of the world aquaculture products. China is the most important producer of aquaculture products in the world, producing 58% of the global aquaculture products. European aquaculture production represented only 1.2% of the world aquaculture production in terms of weight and 1.9% in value.

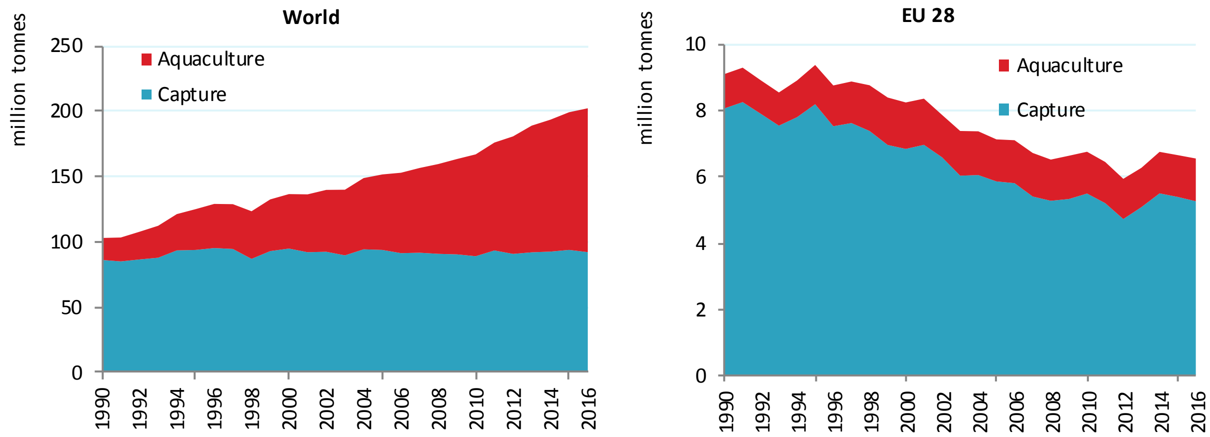


Figure 2.1: World and EU28 seafood production (capture and aquaculture): 1990-2016.
Source: FAO, 2018

The aquaculture production in EU has increased by 24% from 1990; however, since 2007 the production has decreased by 2%. As EU capture fisheries production has been showing a decreasing trend from 1990 to 2016, aquaculture has become relatively more important to supply the seafood market. In 2016, the aquaculture sector provided 20% of the fish and shellfish supply in EU.

2.1 The EU aquaculture sector

In this section a special effort has been made by the EWG to present the development of the entire EU aquaculture sector covering all 28 Member States from 2008 to 2016. The totals and the time trends presented in this chapter are based on the data collected under DCF and EU-MAP, supplemented with EUROSTAT and FAO data, estimating missing values where necessary to be able to give a comprehensive overview of the EU aquaculture sector. The methodology used is included as annex V in this report.

Aquaculture production in the 28 EU Member States reached 1.42 million tonnes and accounted for €4.89 billion in 2016 (DCF and EWG estimates). The EU represents 1.2% of the world aquaculture production in volume and 1.9% in value[1]. EU aquaculture production is very concentrated. Spain is the largest aquaculture producer in the EU covering 21% of the production volume, followed by France (15%), the United Kingdom and Italy (both with 14%), and Greece (with 10%). These five countries account for 74% of the total EU aquaculture production volume (Figure 2.2).

In terms of value, United Kingdom is the largest contributor in EU with 21% of the total, followed by France (16%), Spain (13%), Greece (12%) and Italy (11%). These five countries combine 73% of the total EU aquaculture value (Figure 2.2)**Error! Reference source not found.**).

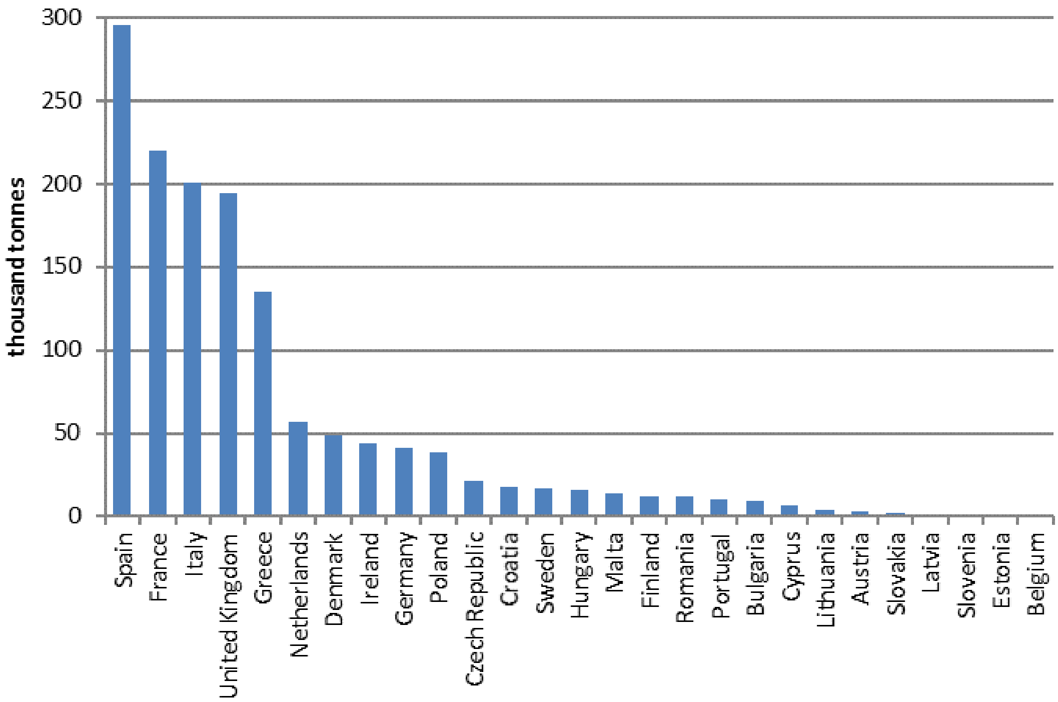
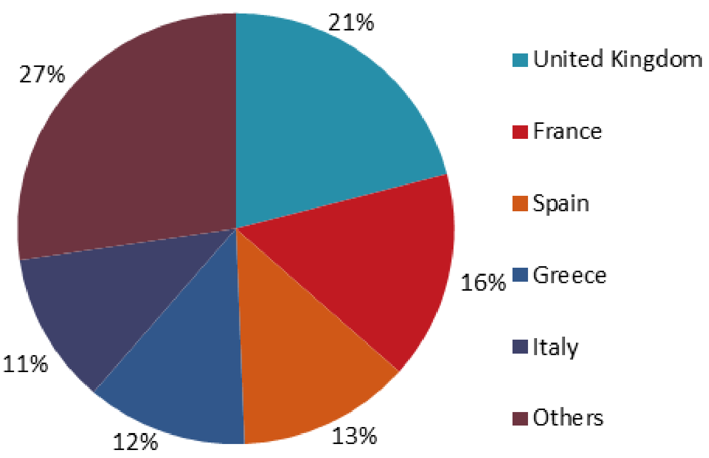


Figure 2.2: Aquaculture production in EU MS in terms of weight: 2016.
Source: EU MS data submission and EWG estimations, 2018.

[1] FAO Fishstat data for fish, crustaceans and molluscs, aquatic plants and animals.

It should be noted that even though Spain has the largest aquaculture production volume (21%) it is only third in value (13%). This is due to the relative low market value of mussels, which represented 74% of the Spanish aquaculture production volume, but only 13% of the sales value.



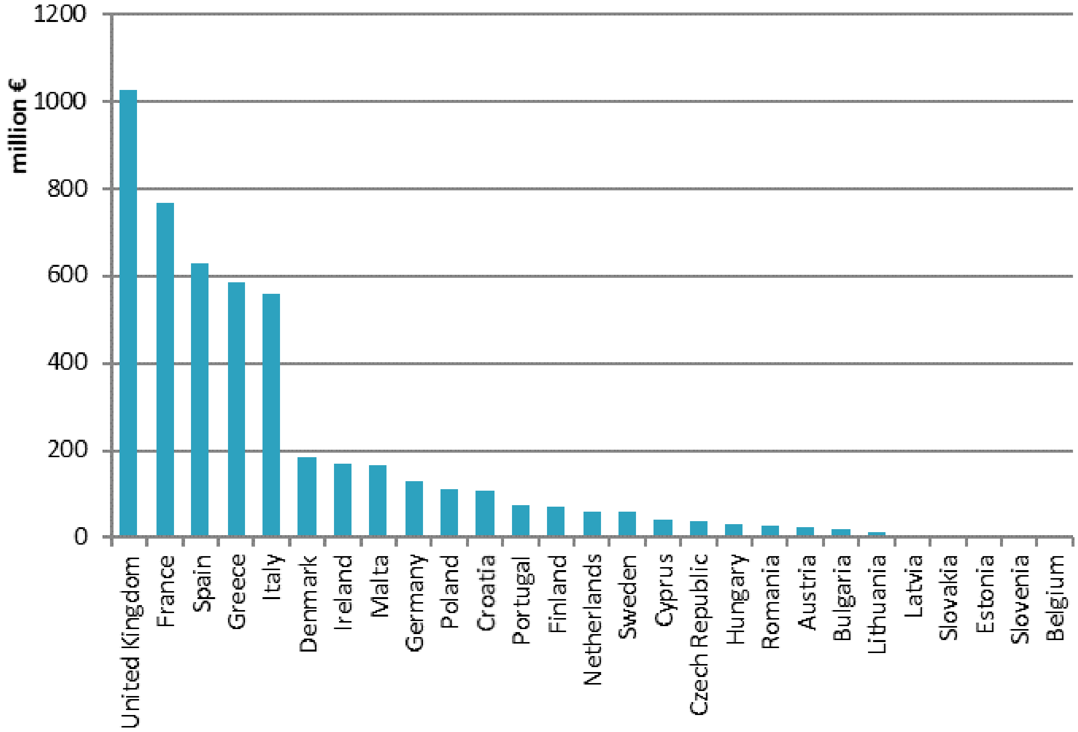


Figure 2.3: Aquaculture production in EU MS in terms of value: 2016.
Source: EU MS data submission and EWG estimations, 2018.

From an employment perspective, the social importance of the aquaculture industry is not always reflected in the contribution, by volume or value, to the EU totals. Shellfish production employs more labour compared to the marine and freshwater production. The shellfish sector most often consists of small family owned businesses and have a large social importance for some regions in EU.

2.2 Economic performance of the EU aquaculture sector

Table 2.1 provides an overview of the size of the EU aquaculture sector across Member States in terms of number of firms, sales (volume and value) and employment. The table shows in more detail the concentration in a few countries but also their different composition of production. For instance, as mentioned above, with over €1 000 million of production, the UK is the largest producer, with a volume of 195 tonnes. On the other hand, although Spain had a much larger production (295 tonnes), this only reached a value of €627 million. A more detailed analysis of these indicators is presented in this Section.

Table 2.1: Economic and employment indicators for the EU aquaculture sector: 2016.

Country	Number of enterprises	Total sales volume	Turnover	Employment	FTE
	number	*thousand tonnes*	*million €*	*number*	*number*
Austria	51	3	22	286	171
Belgium	1	0	0	6	3
Bulgaria	588	9	21	1,046	923
Croatia	187	17	109	2,192	1,625
Cyprus	16	7	42	522	459
Czech Republic	90	21	39	1,506	904
Denmark	107	48	185	549	366
Estonia	10	0	2	41	34
Finland	173	13	70	495	341
France	2,700	220	765	15,074	8,837
Germany	293	41	129	1,638	983
Greece	328	135	584	3,986	3,482
Hungary	72	16	32	2,124	1,274
Ireland	289	44	168	1,948	1,027
Italy	711	201	557	5,460	3,289
Latvia	85	1	6	250	169
Lithuania	28	4	12	501	301
Malta	6	14	164	301	256
Netherlands	70	56	60	189	206
Poland	1,242	38	110	8,759	5,256
Portugal	1,402	10	74	2,650	829
Romania	430	12	28	3,699	2,912
Slovakia	11	2	5	641	385
Slovenia	7	1	1	20	20
Spain	2,990	295	627	17,811	6,534
Sweden	136	17	60	489	295
United Kingdom	473	195	1,023	3,285	2,802
Total EU	**12,496**	**1,422**	**4,893**	**75,466**	**43,680**

Source: EU MS data submission (DCF, EU-MAP), Eurostat, FAO and EWG estimations, 2018.

Number of enterprises

A total of almost 11 thousand enterprises were reported under DCF and EU-MAP, in 2016. It is further estimated that the total number of enterprises in the EU aquaculture sector is around 12 thousand and 13 thousand taking into account the EU countries not reporting data. This number has remained rather stable since 2008 (Figure 2.4).

The majority of the enterprises in the EU aquaculture sector are micro-enterprises with less than 10 employees. In 2015 and 2016 these comprised almost 90% of all aquaculture enterprises in the EU. These micro-enterprises most of the time tends to be family owned and are use rather extensive production methods and systems. The number of microenterprises remained almost unchanged between 2015 and 2016, whereas the estimated data indicates that there has been a slight increase (3%) in the number of enterprises employing 10 employees or more from 2015 and 2016.

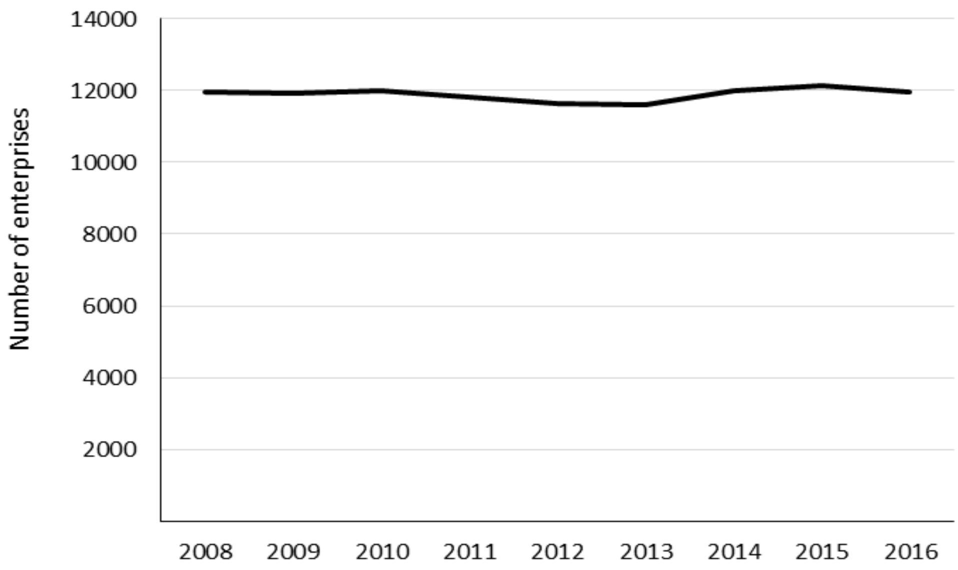


Figure 2.4: Total Enterprises in the EU Aquaculture sector: 2008-2016.

Source: EU MS data submission and EWG estimations, 2018.

Production and sales

The total EU aquaculture production is estimated to be 1 404 and 1 422 million tonnes in 2015 and 2016, respectively. This corresponds to a 1% increase over a year and a 4% increase since 2014[2].

[2] The sales volume is defined as output from aquaculture at first sale, including production from hatcheries and nurseries offered for sale. It should be noted that total sales are used as an estimate of total production. Article 2, of the EC Regulation No 762/2008 of the European Parliament and of the Council of 9 July 2008 on the submission by MS of statistics on aquaculture and repealing Council Regulation (EC) No 788/96.

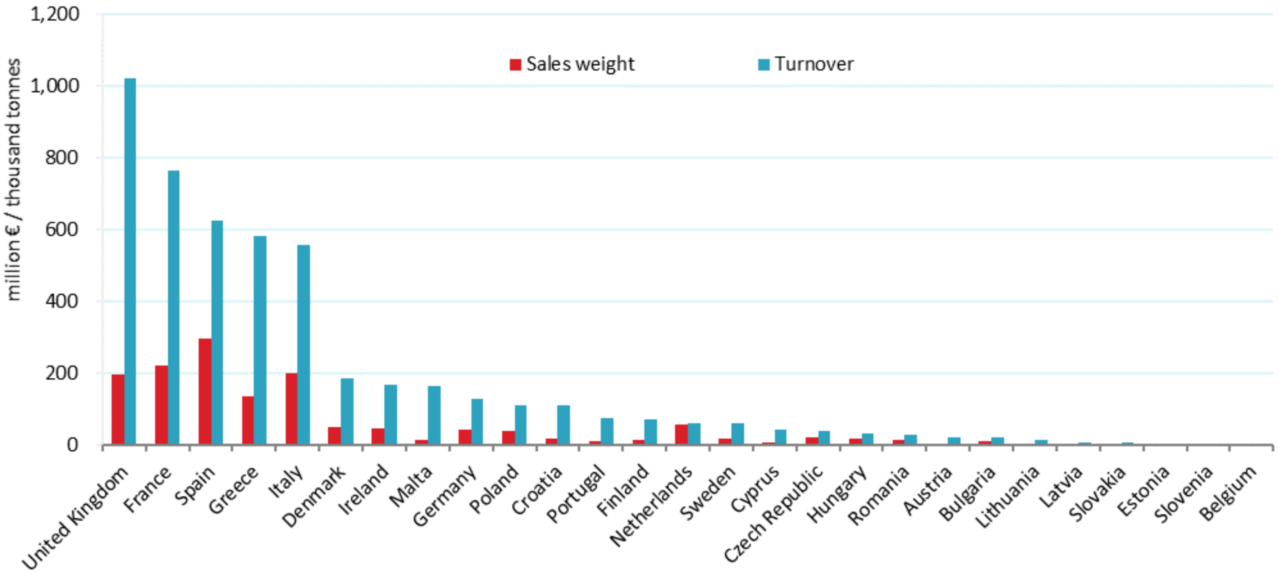


Figure 2.5: Total sales weight and turnover in the EU Aquaculture sector per MS: 2016.
Source: EU MS data submission and EWG estimations, 2018

Large differences in the volumes and turnovers from aquaculture are observed across EU Member States (Table 2.1 and Figure 2.5**Error! Reference source not found.**). There are five major roducers: the United Kingdom, France, Greece, Italy and Spain with reported turnovers between €550 million and €1 100 million. All other countries have reported turnovers less than €200 million.

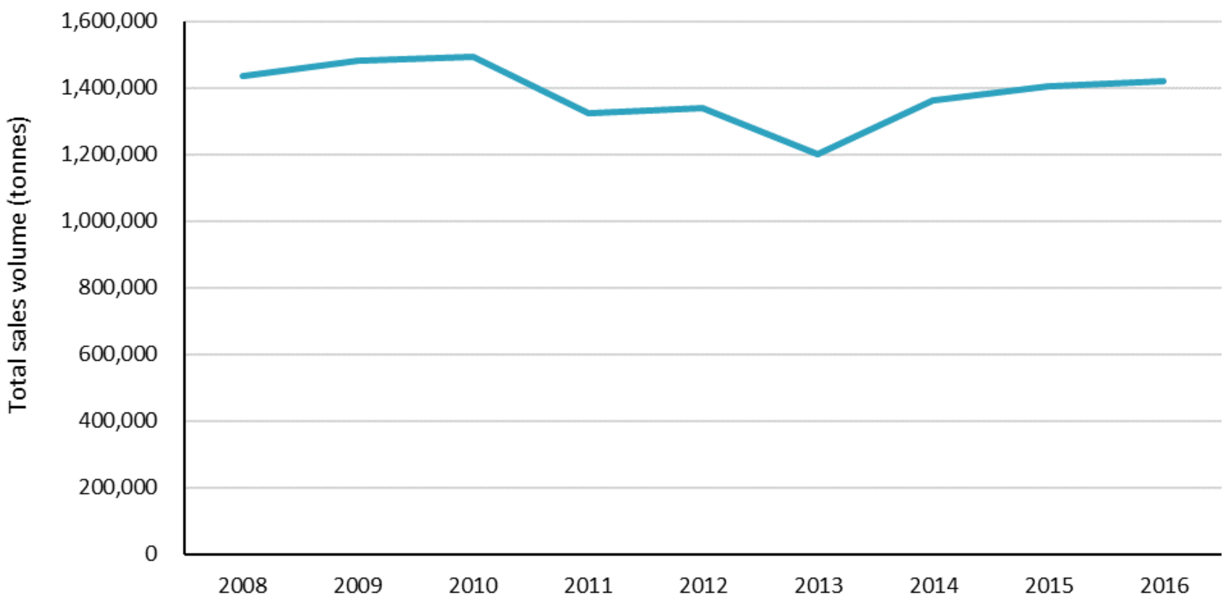


Figure 2.6: Total production in the EU Aquaculture sector: 2008-2016.
Source: EU MS data submission and EWG estimations, 2018.

Figure 2.6 show the aggregated total production in the EU aquaculture sector from 2008 to 2016. Between 2008 and 2016, the overall EU production seems to be rather stable slightly above 1.4

million tonnes (Figure 2.6**Error! Reference source not found.**). However, a noticeable ecrease is observed between 2010 and 2013, which is mainly due to a decrease in the production of mussels affected by environmental conditions, such as “red ties” in Spain, and shellfish diseases. The recovery from 2013 to 2016 can again be explained by increasing productions of shellfish catching up from earlier years.

Turnover

The total value of sales (nominal) from the EU aquaculture sector is reported to have been €4 616 and €4 893 million in 2015 and 2016, respectively. This represents a 6% increase over a span of two years. A driver to the increase in turnover recorded between 2013 and 2014 and the continuous increasing trend is a general rise in prices, where salmon is a good example. The increasing prices together with the increase in the overall production in the EU aquaculture sector contributes to the increase in turnover in both nominal and real prices from 2013 to 2016 (figure 2.7).

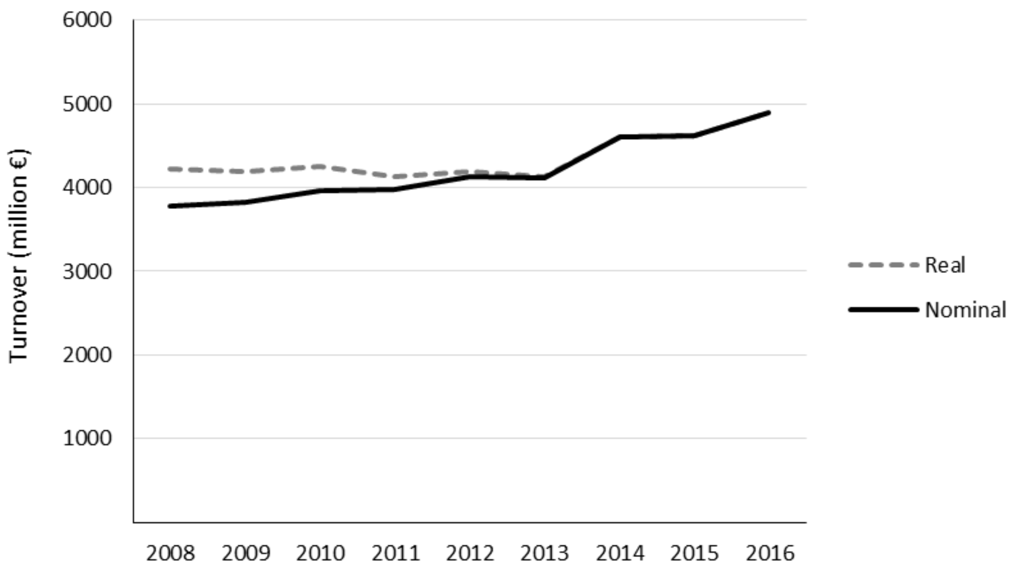


Figure 2.7: Aquaculture turnover in nominal and real values at EU28 level: 2008-2016.
Source: EU MS data submission and EWG estimations, 2018

Employment

The reported data displays an employment of about 59 500 persons in 2016. Based on the data available for both 2015 and 2016, employment increased by 2% from the 58 200 employed reported in 2015. Taking into account the estimates for the Member States not reporting data, the EU 28 aquaculture sector directly employs around 75 000 persons, (figure 2.8).

Looking at the full time equivalents (FTEs) of the data collected under DCF and EU-MAP, there has been an increase of 2% from the 32 700 FTEs reported in 2015 to the 33 400 FTEs reported in 2016. Overall, it is estimated that in 2015 and 2016, the FTEs in the EU aquaculture sector amounted to 42 000 and 44 000 in 2015 and 2016, respectively.

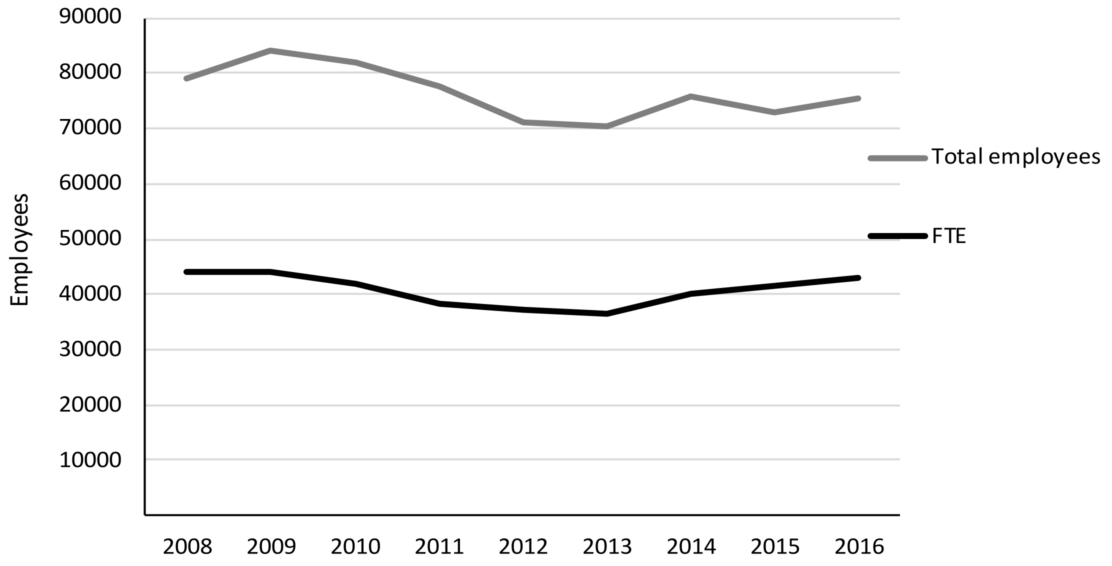


Figure 2.8: Numbers of Employees and FTE's in the MS Aquaculture sector: 2008-2016.
Source: EU MS data submission and EWG estimations, 2018.

From Figure 2.9 it can be seen that employment varies a lot between countries. The employment is depended on which kind of aquaculture production is the most common one in terms of species and technique used in each country. The shellfish sector is labour intensive and use a lot of part time workers illustrated by countries like Spain and France, whereas the marine production is more capital intensive and use mostly full time employed illustrated by countries like the UK and Greece.

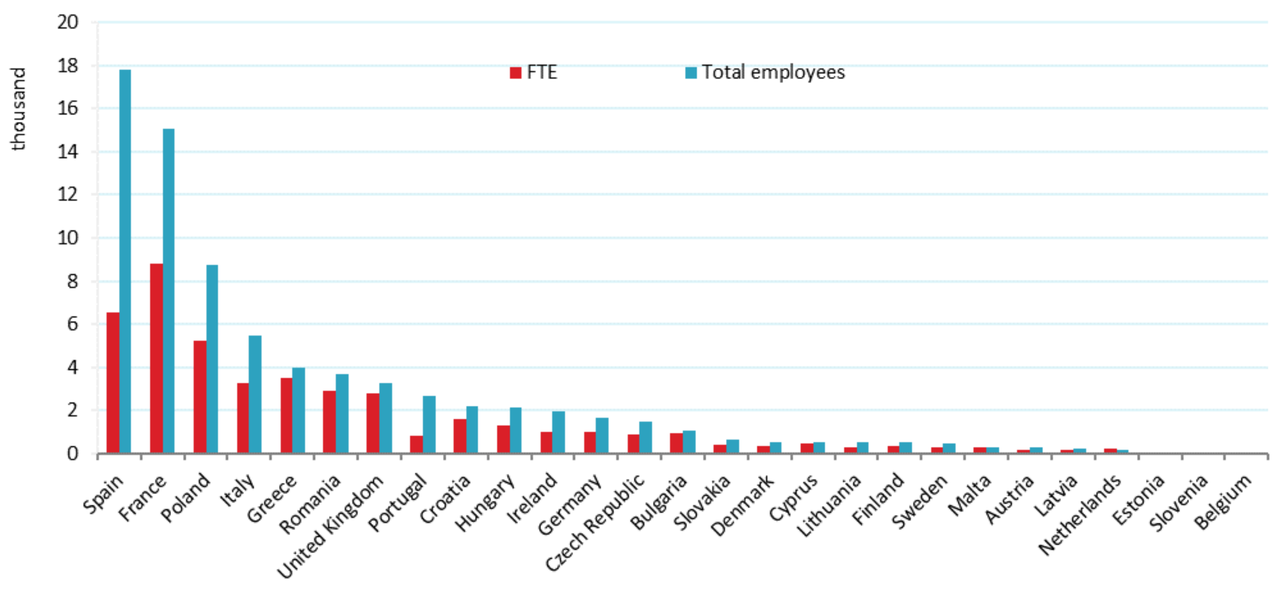


Figure 2.9: Numbers of Employees and FTE's in the Member States Aquaculture sector: 2016.
Source: EU MS data submission and EWG estimations, 2018

The EU aquaculture sector has a significant component of part-time work. This can be seen from the ratio of full time equivalents (FTE) to total employees. The lower the ratio, the more part-time or seasonal work exists, while the higher (closer to 1) the ratio, the more occupation is full time. The estimated data shows that the ratio for the EU aquaculture sector was 0.58 in 2015 and 0.59 in 2016. This is a continuation of what was observed in the last report, where there also was a tendency towards less part-time employment in the aquaculture sector. The large proportion of part-time and seasonal employment in the sector is mainly due to the shellfish segments, which have a significant percentage of part-time and seasonal work.

Mean wages

The average wage is calculated as the sum of the costs in wages and salaries and the imputed value of unpaid labour divided by the total number of employees or the total number of FTEs. The average wage per FTE was about €25 000 per year in 2016. This is an increase of around 7% from the €23 400 reported in 2014.

The wages paid in each Member State is very different dependent on labour productivity and the different aquaculture systems applied in each country. The average wages varied from €2 600 per year to €67 000 per year, in 2016.

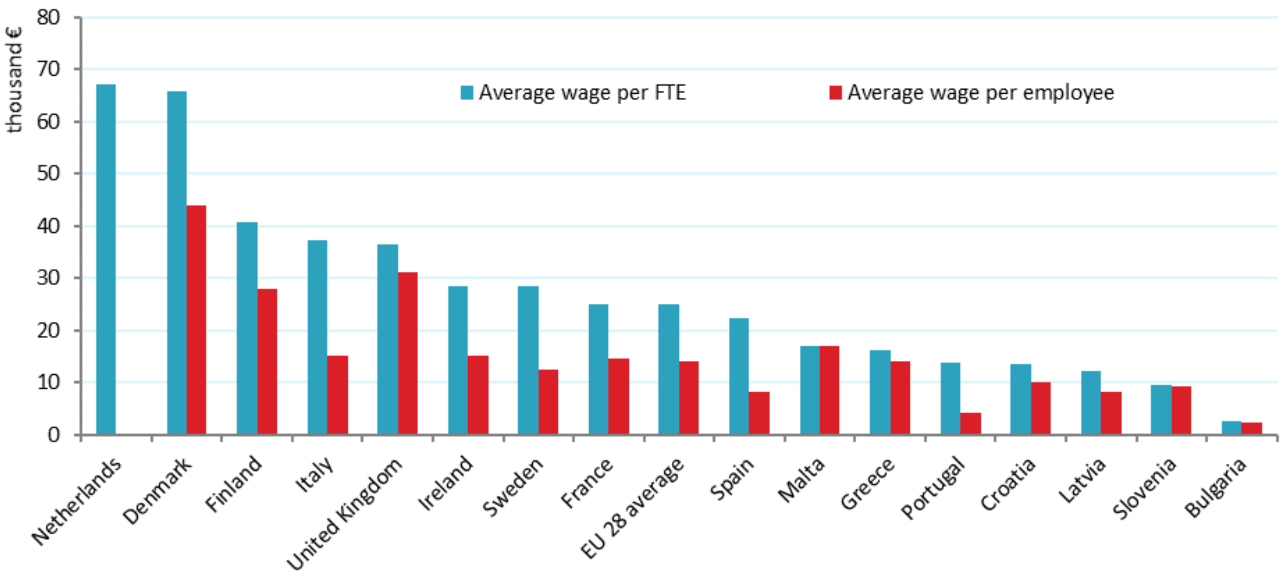


Figure 2.10: Average wage in the EU Aquaculture sector per MS: 2016.
Source: EU MS data submission and EWG estimations, 2018

Gross Value Added

The data reported shows that the EU aquaculture sector generated about €1 739 and €2 062 billion Gross Value Added in 2015 and 2016, respectively. This implies that GVA has increased by 29% since 2014 and 19% from 2015 to 2016.

EBIT (Earnings Before Interest and Taxes or Operating Profit)

The profitability of the EU aquaculture sector has been improving in 2015 and 2016 with a reported total EBIT of €782.8 million and €1 248.7 million, which continues the increasing trend shown since 2014. Indeed, EBIT more than tripled since 2014.

ROI (Return On Investment)

ROI is a performance measure to evaluate the profitability of an investment. ROI is calculated as EBIT divided by total assets. Data show an average ROI of 19.4% in 2016, which is approximately an 8% increase from the ROI reported in 2015. The operating profit margin or EBIT ratio can be obtained by dividing the EBIT by the turnover and is estimated at 25.5% in 2016. The ROI for aquaculture is usually considered a better measure of the long term viability of the sector than the operating profit margin.

Table 2.2: Economic performance Indicators for the EU aquaculture sector: 2016.

Country	GVA	EBIT	ROI	Average wage	Labour productivity	Capital productivity	Future Expectations Indicator
	million €	*million €*	*%*	*thousand €*	*thousand €*	*%*	*%*
Bulgaria	23.1 ▼	18.6 ▲	22.1 ▲	2.6 ▼	11.9 ▼	27.4 ▼	2.8 ▼
Croatia	49.5 ▼	22.4 ▼	8.1 ▲	13.5 ▲	30.0 ▼	18.0 ▲	3.1 ▼
Denmark	44.9 ▲	12.1 ▲	5.9 ▲	65.7 ▼	122.7 ▲	21.9 ▲	0.4 ▼
Finland	39.4 ▲	5.0 ▼	2.1 ▼	40.6 ▬	57.8 ▲	16.8 ▼	-1.0 ▼
France	421.1 ▲	130.8 ▲	12.7 ▲	25.1 ▲	47.7 ▲	40.8 ▲	-1.4 ▼
Greece	209.9 ▲	145.8 ▲	13.4 ▲	16.2 ▬	60.3 ▲	19.3 ▲	0.1 ▼
Ireland	71.0 ▲	40.3 ▲	21.1 ▲	28.5 ▼	69.2 ▲	37.2 ▲	0.8 ▼
Italy	185.0 ▼	103.8 ▼	24.1 ▲	37.2 ▬	97.7 ▲	42.9 ▲	28.2 ▬
Latvia	5.6 ▲	1.5 ▼	2.8 ▼	12.2 ▬	16.5 ▲	10.6 ▲	-4.5 ▼
Malta	37.0 ▲	26.6 ▲	50.5 ▲	17.1 ▼	82.6 ▼	70.1 ▲	0.8 ▼
Netherlands	35.4 ▼	18.9 ▼	14.0 ▼	67.0 ▲	172.4 ▼	26.2 ▼	3.5 ▼
Portugal	83.6 ▲	55.9 ▲	60.2 ▲	13.7 ▲	100.8 ▲	90.0 ▲	14.9 ▲
Slovenia	0.8 ▼	-0.1 ▼	-1.0 ▼	9.5 ▼	42.4 ▼	11.0 ▼	-9.5 ▼
Spain	238.9 ▲	74.0 ▲	10.8 ▲	22.4 ▲	36.6 ▲	34.7 ▲	-0.6 ▼
Sweden	43.3 ▲	19.7 ▲	15.3 ▲	28.4 ▼	68.3 ▲	33.8 ▲	-1.4 ▲
United Kingdom	573.3 ▲	573.3 ▲	33.0 ▲	36.6 ▼	101.8 ▲	33.0 ▲	3.7 ▲
Total EU	**2,062.0** ▲	**1,248.7** ▲	**19.4** ▲	**25.0** ▼	**59.7** ▲	**32.0** ▲	**3.0** ▲

Source: EU MS data submission, 2018.

Labour productivity

The labour productivity is calculated as the total costs in wages and salaries and the imputed value of unpaid labour divided by the total number of FTEs. Data shows that the labour productivity for the EU aquaculture sector was about €50 thousand and €59.7 thousand per FTE in 2015 and 2016, respectively. This represents a 20% increase from the €49.6 thousand per FTE reported in 2014.

There is a large variation between Member States in the estimated labour productivity. Bulgaria and Latvia had the lowest labour productivity with €11.9 thousand and €16.5 thousand, whereas Netherlands and Denmark had the highest with a labour productivity of €172.4 thousand and €122.7 thousand, respectively.

Capital Productivity

Capital productivity is calculated as Gross Value Added (GVA) divided by Capital value (total value of assets) in percentage and describes the average value added to the economy per unit of capital invested in the aquaculture sector. Data shows that the capital productivity for the EU aquaculture sector was 24.3% in 2015 and 32% in 2016, which shows a significant increase in capital productivity over a one-year period.

Future Expectations Indicator (FEI)

The FEI indicates whether the industry in a sector is investing more than the depreciation of their current assets. Data show that the FEI for the EU aquaculture sector was estimated to be negative at 2.4% in 2015 and positive 3.0% in 2016. This represents a continuous improvement from the negative 5.8% FEI reported in 2014. The industry seems to be investing more in itself, and consequently should have more positive expectations on the future development of the sector.

2.3 National summaries

2.3.1 Austria

Austria is a landlocked country producing only freshwater aquaculture. The Austrian aquaculture sector produced 3.5 thousand tonnes in 2016 and the estimated production value was €20 million (Eurostat, 2016).

Rainbow trout remains the main species produced, representing 35% of the total weight and 38% of the total value of production in 2016. Other important species are common carp, covering 17% of the weight and 15% of the value, and brook trout, accounting for 14% of the weight and 11% of the value.

2.3.2 Belgium

Aquaculture production in Belgium is very minor. According to FAO, the aquaculture production in Belgium was below 50 tonnes in 2016.

2.3.3 Bulgaria

Production volume and value

In 2016, the turnover was €21 million, 22% more than in 2015, and a 70% increase when compared to the average over the period 2008-2015. The total sales volume in 2016 increased by 33% compared to 2015, reaching 9.5 thousand tonnes. Total sales saw a 91% increase compared to the average over the period 2008-2015.

Overall industry structure and employment

In 2016, Bulgaria had 557 active aquaculture enterprises with 5 or less employees, 21 enterprises with 6-10 employees and 10 enterprises with more than 10 employees. Total employment in 2016 was 1 046 jobs, corresponding to 970 FTEs. The level of employment decreased between 2009 and 2012, but increased in the period 2013 and 2016. The number of enterprises in 2016 with less than five employees has increased by 4% compared with 2015, while the number of enterprises with 6-10 employees and more than 10 employees decreased by 22% and 17% respectively compared to 2015. The average wage in 2016 decreased by 17% compared to 2015, but it was 14% more than the average for the period 2008-2015.

Main segments

The four main segments generated 88% of the whole aquaculture production in Bulgaria and 84% in terms of sales value. The largest segment, regarding sales value remain the trout cages, while the segment with highest production volume is the carp on growing.

Current production trends and main drivers (Trends and triggers)

The main species produced by the Bulgarian aquaculture enterprises are rainbow trout, carp and Mediterranean mussel. The production of carp followed a stable trend until 2015, due to the culture and traditions of the people. Compared to 2015, the carp production in 2016 marked significant growth and increased by 76% in terms of volume and 75% in terms of value. This growth was due to the export orientation of this sub-sector of the market. The cultivation of rainbow trout and Mediterranean mussel continues to grow as the demand for these species is also growing not only for the domestic market but also for export.

Outlook

The diversified production of species with high market price, as well as organic produce based on the traditional extensive technologies could be used for the increase of the aquaculture production. Another possibility to unleash the potential of the sector is by the adding of value to own production by processing and export.

This goal from the Bulgarian national strategy on aquaculture seems achievable by the introduction of innovations, the development of market chains and by producing species with high foreign market value or significantly improved products.

Improving the competitiveness of the enterprises can be achieved also by the general modernization of the enterprises, improving their resource efficiency and fulfilling the measures to protect waters and their conversion to intensive or super-intensive innovative technologies. Applying environmental measures and subsidies for new farms for organic production is expected to reduce the impact of aquaculture on the environment.

2.3.4 Croatia

Production volume and value

Croatian aquaculture sector, altogether marine and freshwater, produced 16.9 thousand tonnes in 2015 and 17.3 thousand tonnes in 2016. The total value of production was €108.6 million in 2016, which corresponds to an increase of 5.7% over the same period in 2015. Croatian aquaculture production has remained stable over the period 2012-2016. In earlier years there was no data collection under the DCF in Croatia as the country joined the EU in July 2013.

Overall industry structure and employment

During the reference years, the number of enterprises ranged around the same number with very little fluctuation. Significant is that 80% of the enterprises are small producers with less than 5 employees, with approximately the same percentage over the entire period analysed.

Main segments

The production in Croatia can be divided into a few main segments, distributed among marine and freshwater segments. Regarding the new EUMAP segments and recent trends in production techniques and volumes, the production in Croatia has been divided into seven main segments. That lead to certain changes compared to previous time series, in general making it simpler, aligned with trends in production and more or less comparable through the whole time period.

In terms of freshwater segments, the largest is the land based production of carp with combination of hatcheries, nurseries, raceways and ponds for on growing. Other freshwater segments are trout in land based farms, which is mostly small scale production. In freshwater aquaculture, the main production techniques are ponds and raceways.

Marine production consists of finfish, bluefin tuna and shellfish. As in previous years, only few farms produced a combination of all mentioned species with one predominant species in terms of volume and value. Economically the most important are fast growing finfish farms, farming predominantly sea bream and sea bass and tuna farms although this segment consists on just 4 enterprises during the whole period. Shellfish farms are mainly small-scale family owned production producing mostly mussels and smaller volumes of oysters. Since oysters are an important species in terms of long tradition of farming, preservation and great potential for added value, according to National Strategic Plan for Aquaculture 2014-2020, farms with predominant production of oysters are separated into a special segment in 2015 and 2016 to be monitored in the next period.

Current production trends and main drivers (Trends and triggers)

Croatian main export product is sea bass, together with sea bream, exported mostly to the EU market. Another important aquaculture export product is tuna, exported to Japan. Other products are intended for domestic market and some for other EU countries. After three years of decline in economic performance and reaching the lowest level of production in 2014, 2015 and 2016 show signs of recovery in terms of production and economic indicators. Compared with the previous period, 2012-2014, where fish consumption per capita continuously decreased (related to the economic crisis), according to estimation of EUROSTAT, it has increased in 2015. As production grew, mostly in finfish sector - as a consequence of progress in technology, foreign market opening and using financial instruments from EMFF - some changes consequently occurred in fish consumption. As previous studies on perception of aquaculture presented, the most important factor driving consumption frequency in fresh fish is the price. Slight decline of average prices of farmed fish at fish market in Croatia has made farmed fish more affordable. Although a marketing strategy at the national level hasn’t been adopted, large companies have made a great effort to promote farmed fish as tasty and healthy. These changes at the national level regarding the image of farmed fish could further increase the demand for aquaculture culture products on the domestic market.

Outlook

In accordance with the Croatian National Strategic plan for aquaculture 2014-2020, there was a significant increase of aquaculture production, but there are also signs of future improvements in a wider area, from organic production, medicaments, environment protection, diseases and predator prevention, sustainable development to enforcement of social business-political environment, increase of national consumption, aquaculture products etc. Organic production is at its very beginning, applied experimentally only in one company farming sea bass and sea bream. Funds form EMFF for transition to organic production are in preparation to be available from 2019 onwards, so first results on organic production could be expected in the next reporting period.

2.3.5 Cyprus

The Cypriot aquaculture sector produced 6.6 thousand tonnes in 2016 and the estimated production value was €36.2 million (Eurostat, 2018). Sea bream is the main species cultured in Cyprus and accounts for 76% of the total volume and 70% of total value of production in 2016. Sea bass on the other hand accounts for 23% of the total volume and 28% of the value produced in 2016. Due to production threshold, the country is not expected to provide economic data for this report.

2.3.6 Czech Republic

Total aquaculture production in the Czech Republic was 21 thousand tonnes in 2016, and maintains production levels around 20 thousand tonnes over the period 2008 - 2015. Instead production value was about €47 million, showing an increasing trend, which indicates a rise in prices.

The Czech Republic is a country with a long tradition of fish farming. Being a landlocked country, only freshwater species can be raised in the country. Production is generally characterized by extensive and semi-intensive fish farming in ponds. There are 52 000 ha available for fish farming, of which 41 000 ha are used for fish production.

Common carp dominates with 88% of the total aquaculture production in weight and 82% in value.

2.3.7 Denmark

Production volume and value

In total, the Danish aquaculture sector produced 48 200 tonnes in 2016, which is a decrease of 4% from 2015, due to a decrease in production in marine aquaculture from 2015 to 2016. However, it is an increase of 4% from 2014. The total value of the production was €185 million in 2016, which is an increase of 1% from 2015 and an increase of 16% from 2014. Compared to the average from 2008 to 2015, the total volume increased by 7%, whereas the total sales value increased by 23%.

The sector performed well in 2016 with a net profit of €9.7 million. At the same time gross value added increased 24% and EBIT increased 58%. Capital productivity is 21.9% and ROI is 5.9%.

Overall industry structure and employment

In 2016, the total population of aquaculture farms was 211, which was distributed on 107 enterprises. The Danish aquaculture sector is dominated by small enterprises with less than 5 employees; corresponding to 83% of the enterprises in 2016.

Main segments

The production in Denmark can be divided into four main segments. The largest segment is the land based production of trout, which consists of a combination of hatcheries, nurseries and grow-out farms. The production in the land based farms is typically small portion size trout for consumption. The production techniques used are primarily ponds, tanks, raceways and recirculation systems.

The second most important segment is the marine production of trout and trout eggs, which are produced in sea cage farms. The third segment consists of land based recirculation farms producing European eel, pike-perch, salmon and turbot. Finally, the forth segment is producing blue mussels on long lines.

Current production trends and main drivers (Trends and triggers)

The portion sized fresh water rainbow trout is mainly exported to Germany, whereas the trout eggs harvested from the marine sea cage farms are exported to Japan. Eel, pike perch and turbot are exported to other EU countries.

Outlook

For the Danish trout producers, the outcome for 2017 is expected to be about the same as in 2016. Even though the Danish regulation for aquaculture production was changed in 2012, and that this change should provide the producers with an incentive to introduce more environmental friendly technology in order to raise production, there has only been a small increase in production and, in turn, a small decrease in prices.

The eel farmers are expected to decrease production due to the restriction on the harvesting of glass eels. Furthermore, this restriction drives up prices on glass eels making it less profitable to produce eel. The mussel farmers are expected to increase production and turnover, but it is still questionable if the profit will be positive.

2.3.8 Estonia

Production volume and value

Enterprises whose primary activity was defined as "Fish farming" produced 427 tonnes rainbow trout in 2015, which corresponded to an increase of 17% from 2014 to 2015. On the other hand, the total value of the production was €1.63 million in 2015, which corresponded to an increase of 6% over the same period. From 2008 to 2015, the development trends of total volume and total value increased by 35% and 34%, respectively.

Overall industry structure and employment

In 2015, the total population of primary trout farming enterprises was ten and dominated by small enterprises with less than five employees (90% of the total). The total number of persons employed was 36, corresponding to 30 FTEs.

Main segments

The production of trout is divided into two segments based on fish farming technique. The largest segment is the land based fresh water trout combined farms, which consists of a combination of hatcheries, nurseries and grow-out farms. The second segment is the land based fresh water trout on growing farms.

Current production trends and main drivers (Trends and triggers)

Due to the small volume the rainbow trout are mainly marketed domestically. The production volume of primary trout farming sector has been greatly affected by weather conditions. The production of the Estonian aquaculture sector decreased significantly in 2011 due to the heat wave in 2010, which caused a great loss in rainbow trout production. Undoubtedly this event had an impact on production also in the following years. However, current data show that production volumes of the Estonian trout producers are recovering. In addition to already operating fish farms the growth in production from new farms, which were established with support from the EFF, is increasing. Companies have begun to invest in indoor fish farming (closed) aquaculture systems. Although these farms are energy consuming, they give the opportunity to grow and deliver production throughout the year and more environmentally friendly. Also they are no longer dependent on environmental conditions. According to the data from Statistics Estonia the trout production increased 26% in 2017, compared to 2015.

Outlook for future production trends

Currently, Estonian fish farmers have difficulties to compete with imported trout and salmon products in the domestic market. According to the Estonian multiannual national plan for the development of sustainable aquaculture the vision for 2020 is to build up a leading position in the domestic market of Estonia and become a successful exporter of species that suit local farming conditions and have a high demand in foreign markets (e.g. eel, sturgeons, whitefish, perch, pike-perch, crayfish). Priority is given to developing the competitiveness of already existing businesses and to investing in the expansion of companies which are successful on the market. The probable volume of the Estonian market for aquaculture products is estimated at 6 500 tonnes in 2020. Thus, to achieve the vision, Estonian aquaculture production must reach more than 3 000 tonnes of sales. This number is consistent with the investments are made in aquaculture sector.

2.3.9 Finland

Production volume and value

The Finnish aquaculture sector produced 12 517 tonnes of fish and fry in 2016 generating a total turnover of €70 million. Despite a slight decrease in the volume of production the revenue increased by 10% due to the improved prices.

The food fish production consisted mainly of rainbow trout. Almost 90% of the total production value and over 90% of the production volume was generated by rainbow trout in 2016. European whitefish production is also important part of the Finnish food fish supply. European whitefish accounted for 9% of the production value and 5% of the total production volume in 2016. The production of fry in fish farms consists mainly of rainbow trout fry for food fish farming. Fish farms produce also Baltic salmon, landlocked salmon, brown trout, sea trout, char and brook trout fry. Hatcheries and nurseries segment generated one quarter of the total turnover of the sector in 2016.

Overall industry structure and employment

There were 173 main activity aquaculture companies in operation in Finland in 2016 with employment of 495 persons totalling 341 FTE. The aquaculture sector is getting more and more concentrated: The ten biggest companies in the sector in terms of turnover made up over half of the total revenues in 2016.

Main segments

Finnish aquaculture sector is divided in new EUMAP regulation into 5 segments. The most important farming method is the trout cage farming that consists of marine rainbow trout and European whitefish production. Two other trout production methods are inland production in tanks and raceways and recirculation systems. Hatcheries and nurseries produce juvenile segment include also farms that have rainbow trout production. The last and least segment is the natural ponds that produce freshwater juveniles mostly for restocking.

In previous segmentation according to DCF there was a segment of combined production of juveniles and food fish that was the biggest segment. These companies are now in the new segmentation according to EUMAP allocated based on main type of production. This has increased significantly the production and revenue of the trout cage production and hatcheries and nurseries segments compared to the results based on previous segmentation for 2008-2014.

Current production trends and main drivers (Trends and triggers)

The environmental policy has restrained the intensifying the Finnish aquaculture production and consequently the sector has not been able to benefit from the economies of scale. Due to the tight environmental permit policy, some of the Finnish aquaculture producers have moved their production to Sweden where the environmental regulation is more favourable for the aquaculture production. Annually some 10 thousand tonnes of rainbow trout are imported from Sweden to Finland.

Finland has a national spatial planning program for aquaculture in order to direct the aquaculture production into areas where it is suitable for both the environment and the industry. In this way, the environmental effects can be minimized together with creating possibilities for production growth and improving the profitability of the sector.

Number of recirculating systems units have increased in recent years. There were 6 recirculating systems units in operation in 2016, producing 400 tonnes of fish with a value of €3.6 million. However, high production costs as well as risks related to introducing new technologies impose challenges for this technology. The poor profitability - companies are making losses – have already forced a couple of companies to close down their production for financial reasons.

The competitiveness and performance of the sector is mostly connected to the price developments of fish, mainly rainbow trout and salmon, but also developments of the feed cost play an important role. Almost all aquaculture production in Finland is consumed in the domestic market. However, in 2016 the exports of rainbow trout increased a third to 3.6 million kilos. Imports of aquaculture products - mainly Norwegian salmon - account for about 40% of the total fish consumption in Finland.

Outlook

The total food fish production was 14 400 tonnes in 2016. Despite a slight decrease in volume the value of the production increased marked 29% due to the increased price together with global salmon price. These figures include all aquaculture fish production for human consumption in Finland, not only the production of the main activity companies. In addition to food fish, aquaculture sector produced fry totalling 50 million individuals of different ages, both for stocking and further rearing.

The administration of national environmental control system is being developed and reorganized in order to make the system more predictable to attract more investments in the sector. The Finnish government, research organizations and aquaculture industry are working together to find new innovative ways for increasing the marine aquaculture production without increasing the nutrient load in the Baltic Sea. Nowadays the nutrient load of aquaculture production per tonne of fish produced is only one third of what it was in the 1980s. Better spatial planning and transferring marine aquaculture production in big production units further to the open sea have potential for increasing the production. Offshore open sea production has been piloted in the recent years, but it still faces some technical challenges.

Recirculating aquaculture systems have become more common in Finland in the recent years. The recirculating systems have a great potential as the nutrient load can be easily managed while it is possible to maintain optimal culturing conditions all year round. However, high production costs as well as risks related to introducing new technologies impose challenges for this technology.

Another potential for increasing the production environmentally friendly is using Baltic Sea fish feed for nutrient neutral aquaculture production. In 2016 a new fishmeal plant started producing Baltic Sea fish feed. The idea is that the nutrients of the Baltic Sea are recycled by using Baltic Sea fish feed made of Baltic herring for aquaculture production. This creates an opportunity for nutrient neutral growth fish farming. The plant was built with EMFF support.

2.3.10 France

Production volume and value

In global, the French aquaculture sector produced 219.7 thousand tonnes and €765.2 million in 2016. In comparison with the previous report, it is important to highlight that some segment have been removed because of either an achieved sampling rate low (see point Data quality) or economic parameters from 2008 to 2014 were not available for these seven years. The removed segments represent around 15% of the total sales volume and value in 2014 and are: Sea bass & Sea bream Hatcheries & nurseries (segment 3.1), Sea bass & Sea bream cages (seg 3.4), Other marine fish on growing (seg 6.2), Mussel rafts (seg 7.1), Mussel Long line (seg 7.2), Other shellfish Long line (seg 10.2).

The saltwater fish farming is a small sector in France. The sales volume reached 5.1 thousand tonnes and €41.4 million in 2015 (statistical survey 2015, SSP). With hatcheries and nurseries, cages and land-based facilities, the production of sea bass and sea bream represents 73% of the volume and 70% of the value of saltwater fish farming.

It should be also highlighted the production of sturgeon caviar, even if only 22 tonnes from 7 companies were produced, it achieved a value of almost €13.4 million (statistical survey 2015, SSP).

In this chapter, all published data concern only 6 segments for which all economic data are available: Trout on growing (segment 2.2), Trout combined (seg2.3), Mussel Bottom (seg7.3), Oyster rafts (seg8.1), Oyster Bottom (seg8.3), Other shellfish rafts (seg10.1). With these 6 segments, French aquaculture sector produced 219.6 thousand tonnes of farmed product in 2014, which corresponded to a decrease by 2% on 2015. This result accentuate the trend of the previous years (-9% compared to the average 2010-2015). The total value of production showed a slight increase by 1% to €815.3 million on 2015.

Overall industry structure and employment

The French aquaculture sector is largely dominated by bivalve molluscs farming. Shellfish farming is done almost along the entire French coast. The most productive regions are: Poitou-Charentes, Bretagne, Basse-Normandie for oysters; Poitou-Charentes is more oriented toward sales at the latest stage for human consumption while Bretagne and Normandie are important for rearing at an intermediate stage, leading to important commercial exchange between regions. For mussels, regions come in this descending order: Bretagne, Méditerranée, Poitou-Charentes, Basse-Normandie. Freshwater fish farms are located in nearly all regions with a higher production in Aquitaine and Bretagne.

The total number of aquaculture farms is 2 700, decreasing compared to 2015 (-3%). Compared to the average of 2010-2013, Table 4.7.2 shows a decrease of the number of aquaculture farms of 11%. The 6 segments having full economic data sets over the last three years represent 91-93% of the overall turnover.

Main segments

The French aquaculture sector is largely dominated by bivalve molluscs farming. In weight, shellfish farming ranks first with a production of 191.8 thousand tonnes (87% of national total) and €656.5 million for turnover (86%) in 2016. The second group is the freshwater fish sector with 27.8 thousand tonnes (13%) and €108.7 million (14%).

Pacific cupped oysters (*Crassostrea gigas*) sales nearly represent 50% of the whole aquaculture production in weight and 61% in value. Oysters are mainly produced in intertidal areas by elevated cultivation systems (bags on trestles – segment 8.3). In the Mediterranean, where oyster farming mostly takes place in lagoons, other techniques are used, mainly the culture on rope hung under tables; these farms are included in the oyster raft segment (segment 8.1). Their production reaches 8 thousand tonnes and €20.2 million representing respectively 6% and 4% of all the oyster segments.

The previous segment "Oyster Other (segment 8.4)" corresponding to the oyster farmers carrying out offshore activity (rearing on bottom to a depth from 6 to 10 meters) has been integrated in the new segment "On bottom - Oyster". Since 2006, some environmental hazards (hypoxia, predator, Vibrio bacterium) have lead most of oyster farms of this segment to redeploy on the foreshore. The economic and financial characteristics of farms of the segment "Oyster Other" (segment 8.4) are henceforth similar to the previous segment "Oyster Bottom" (segment 8.2), now called "On bottom - Oyster".

Two species of mussels are cultivated in France. Blue mussel (*Mytilus edulis*) and Mediterranean mussel (*Mytilus galloprovincialis*), representing 33% in weight, 19% in value of the whole aquaculture production. Mussel farming in the Channel and Atlantic coasts is almost all based on the blue mussel. The predominant cultivation system relies on fixed wooden poles (so-called "bouchot" technique) used in inter-tidal areas (segment 7.3). In the Mediterranean, mussels are cultivated in raft (segment 7.1), in fact on ropes suspended below large tables. The long line technique (segment 7.2) is being developed on open sea areas (Atlantic and Mediterranean). For some producers on the Atlantic coast, this technique is complementary to the "bouchot" technique. The long lines are used for catching spatfall and for a part of growing mussels. After 2 or 3 month, mussels are fixed on the "bouchot" in order to finish their growth. In this case, these companies are included in the mussel bottom segment (segment 7.3).

In freshwater fish farming, the main production results from the farming of rainbow trout for 91.2% and other salmonids (*brown trout* - *Salmo trutta* - for instance). The segments of trout are still the most important fish production sector in terms of volume sold (27.8 thousand tonnes) and value (€108.7 million).

The production of sturgeon caviar, produced 22 tonnes from only 7 companies, and achieved a value of almost €13.4 million (statistical survey 2015, SSP). The sturgeon's activity also includes some companies that are rearing to maturity females and sell to caviar producers. Caviar production is a new activity and return on investment, due to a long life-cycle, is a limiting factor in the development of the sector.

Current production trends and main drivers (Trends and triggers)

The shellfish sector has undergone decreases in sales in weight over the last few years due to production loss from mortalities of oyster juveniles since 2008, poor growth (2013, 2015) and mortalities of mussel (since 2014).

Due to the increase of feed costs and the foreign competition, the price, margins and profitability of the trout sector remained low at the beginning of 2010's. The freshwater fish sector renews with growth since 2014 but results must be confirmed and consolidated. The control costs from the companies and a high demand from French consumers must allow a positive evolution.

Outlook

Production is not expected to increase significantly in the coming years. Mortalities of oyster juveniles still occur and rearing cycle cover three years; shellfish farmers may hopefully maintain their production with a stable price. Shellfish farmers dread climate change increasing risk of epizootic and the emergence of diseases in the marine environment. This climate change will affect the environmental parameters: temperature change on ocean acidification, on rainfall and therefore the salinity and the concentration and nutrient quality. This will have consequences on future aquaculture output and on the economic results.

In 2017, a severe drought is causing a significant drop in trout production. This situation has forced the professionals to anticipate sales of juveniles and will also result in a decrease in turnover in 2018 for larger sizes (lower yields).

2.3.11 Germany

Production volume and value

In 2015, the German aquaculture sector produced around 32 000 tonnes and around 42 000 tonnes in 2016. The increase is mainly caused by the high fluctuation in blue mussels' landings. Production in freshwater aquacultures remains more or less stable at about 20 000 tonnes, thereof trout farming oscillates at around 11 000 tonnes and carp farming at around 5 000 tonnes. In total, the sector's value was about €118.5 Million in 2016 and €105.5 Million in 2015.

Overall industry structure and employment

The marine sector consists mainly of about 10 blue mussel producers. In total, 127 people were registered as employees in 2016 and 114 in 2015 in the marine aquaculture sector. 1 865 people were employed (including permanent labour, apprentices and caused labour) in the freshwater aquaculture segments in 2016 and 1 891 in 2015; but without considering unpaid labour in a sector, which is characterized by small family farms.

Main segments

Blue mussels on bottom, trout ponds and raceways, carp ponds.

Current production trends and main drivers (Trends and triggers)

Shortage of seed, closing fishing areas, storms, ocean dumping and the ongoing expansion of the pacific oyster are negative impacts towards the blue mussel production and can affect business seriously. Freshwater aquacultures are foremost small family farms, which generally do not have enough capital to invest in modern facilities and stimulate a re-structure of the segment towards a more industrialised production. This further leads to a lack of concentration and a poor market power. Fish farmers in Germany are price takers. Limited licenses for inflow water are seen as barrier for the development of the trout segment. Carp farmers suffer from high fish loss due to cormorant and other protected wild life. For all segments it is criticized that administrative and bureaucratic requirements overstrain small aquaculture farms.

Outlook

The sector has stagnated for several years now. Changes in numbers are more often caused in altered data collection methods rather than real development. There is still a need for measures, which stimulate an establishment of modern production systems and to simplify administrative requirements for small farms. Promising re-circulating systems (RAS) could not fulfil the expectations in the past. Good potentials for growth are seen in the segment of modern salmonid (trout) facilities. There is an existing demand for trout in Germany, which is currently supported mainly by imports from Denmark and Turkey. In the case of carp, it is recommended to balance conservation and aquacultures objectives. If the fish loss due to protected wildlife in carp farming will continue at the actual high rate and not be compensated, carp farms will continue to struggle economically and may be forced to close down in less than one generation in some regions. Actually, there is already a lack of successors. Extensive carp farms are seen as contributors of ecosystem services and regional culture, which maintain the unique pond landscape of the production regions. Their maintenance is a public issue.

2.3.12 Greece

Production volume and value

According to the data provided by Greece, for 2016, the aquaculture production was 135 227 tonnes corresponding to the value of €583.9 million, an increase from the aquaculture production of 2015, corresponding to 122 927 tonnes with a value of €465.8 million.

Overall industry structure and employment

Almost 18% of the aquaculture companies in Greece are large SA and Ltd enterprises, responsible for 80% of total aquaculture product sales. Those enterprises represent mainly the marine finfish aquaculture sector while the freshwater and shellfish aquaculture sector is mainly comprised of small family enterprises.

Total employment in the sector is estimated at 3 786 employees in 2016 or 3 482 in FTE terms and 3 799 employees in 2015 or 3 234 in FTE. Male employees dominate the aquaculture sector as they correspond to 87.9% of the sector for 2016 and 82% for 2015.

Main segments

In both 2016 and 2015, Gilthead sea bream comprised the major part of Greek aquaculture sector accounting for 47% of the production value and 39% of the volume in 2016, while in 2015 the respective values were 43% and 51%. In second place, European sea bass, accounted for 36% of the production volume and 45% of the value in 2016, while in 2015 the respective numbers were 30% and 39%. Although Mediterranean mussel represents a significant part of the volume, producing 19% of the total aquaculture production in both 2016 and 2015, it generated only 2% of the total production value, as a result of the relatively low unit price of mussels. Other fresh water fish and other species contribute 6% to both the production volume and to the production value for the year 2016 while in 2015 it produced 8% in both volume and value.

Current production trends and main drivers (Trends and triggers)

A rise in the production, in particular for sea bass and sea bream, is expected during 2017-2018 mainly as an effect of the higher prices (and thus profit margins) received by the producers during 2014-2016. The restructuring of debt and the bank loans, the changes of the shareholders and the changes of management for the main Greek production companies (during 2015 and 2016 as well as currently pending ones) are also expected to facilitate the rise of the production.

Outlook

An increase in production and investment is expected for the Greek aquaculture sector. Further consolidation of the sea bass and sea bream sector is also likely, and further consolidation of the mussel sector is expected due to continuous years of increasing sales and net profit. A considerable rise of the production is unlikely unless issues of the mussel aquaculture in Greece are not addressed.

2.3.13 Hungary

The Hungarian aquaculture sector produced 17.3 thousand tonnes of fish in 2015. This production was valued at about €30.6 million (EUROSTAT, 2018). Hungary produces no marine or shellfish aquaculture.

According to available EUROSTAT statistics, the common carp was the main specie produced by the Hungarian aquaculture sector, representing 62% in terms of weight and value of total production in 2015. The second most important specie is the North African catfish with 16% of the total weight and 17% of the total value.

2.3.14 Ireland.

Irish aquaculture is mainly of marine species cultured extensively, in less populous areas of the country, particularly along the west coast. There are also a small number of land-based aquaculture facilities, mainly salmon hatcheries and freshwater trout units. The primary species cultured are Atlantic salmon, Gigas oyster and blue mussel. Output in 2016 was 44 000 tonnes, worth €167 million, employing 1948 persons (FTE 1 026) in 289 production units. About 92.3% of the workforce is male. Many aquaculture sites are exposed and challenging environments. Production trends have been cyclical and limited by licenced capacity, seed supply, weather conditions and distance to market among other challenges met by focussing on high quality, sustainable and organically certified products.

Production volume and value

In the period 2015 to 2016, output volume rose from a low of 31 659 tonnes, worth €116.3 million, to 44 018 tonnes, worth €167.7 million in 2016, increases of 39% by volume and 44% by overall value, over the period. The main trend drivers are the recovery of salmon and bottom mussel production and a steady increase in Gigas oyster production. Unit values of the main 4 segments have also increased.

Overall industry structure and employment

Employment has increased from 1 821 to 1 948; by 6.4%. FTE is up 9% to 1 026, indicating the increase is in full and part-time employment. The number of mainly small (0-5 employed) production units has increased overall to 291 from 277, mainly due to new oyster farms gradually coming on stream.

Main segments

The main segments of the Irish industry continue to be, in order of both volume and value; On-grown, (caged) Atlantic salmon (segment 1.4), Bag-and-Trestle oysters (*C. gigas*) (segment 8.4 oysters other), Rope Blue mussels (segment 7.2) and Bottom mussels (segment 7.3).

Current production trends and main drivers (Trends and triggers)

Irish aquaculture recovered in output volume and value to 2016, while there was an overall increase in employment, driven mainly by the salmon on-growing segment recovering from ADG and an increase in licenced oyster operations. Mussel segment employment declines as these become more capital intensive and smaller rope mussel companies either hire better equipped ones for maintenance or harvesting operations or sell out to them entirely.

Outlook

Production in 2017 increased to 45 726 tonnes, worth €199.9 million, with employment of 1 926 persons. Output will continue to be limited by production capacity, unstable environmental constraints and the logistics of moving mainly fresh live product with a relatively short shelf life to distant markets. In addition, Irish mussel products compete in markets with large domestic production output. The possibility of expansion is in curtailing the effects of those constraints and increasing unit value by product differentiation. The outlook in general beyond 2017 is for modest expansion in high-end niche production, moving into new markets such as SE Asia. The move to differentiated, branded products such as Origin Green, Marine Stewardship council certification, etc., will continue while the un-differentiated bulk sales model is abandoned. More than one struggling minor segment may temporarily cease production as new business models are developed and new production sites are applied for.

2.3.15 Italy

Production volume and value

The Italian aquaculture sector has 711 companies, and represents 4 920 employees, equal to approximately 3 000 FTE. In 2015, the sector produced 190 thousand tonnes and €490 million, which corresponded to an increase of 2% in volume and a decrease of 12% in value. In 2015, the total volume, compared to the performance of 2008-2014, decreased by 5%, whereas the total value decreased by 2%. The sector is mature, structurally defined and has changed its initial conformation in terms of production segments. In 2008, for example, the fresh water sector was leading but the trend has moved towards marine production (both fish and mussels, clams, oysters). The trend shows a marked collapse, in 8 years of observation, of the fresh water segment. The performance in volumes reduced by 35% in sales volume and 37% in turnover (rate based on 2015, compared to 2008-2014). The main cause was the lack of new facilities, due to the non-release of new permits and concessions. The natural closure of some production facilities was added to this cause. The best performing segment was that of shellfish, increased by 15% in volumes sold and over 40% in sales value (data referring to 2015 compared to 2008-2014). The marine species recorded a growth equal to 9% (volume) and 23% in turnover (2015 compared to 2008-2014). During 2015, only the mussels sector recorded a positive result, both in volumes (+ 16%) and in turnover, which increased, compared to 2014, by over 30%. The other two macro-aggregates (aquaculture in freshwater and marine species) did not achieve a positive performance in 2015, compared to the previous year. For the freshwater segment, the strong negative performance, which started in 2015 and continued in 2016, was generated by a lack of fattened product. A strong environmental crisis has caused an unexpected reduction in the quantity of water in the basins, so the fish has delayed its growth and, for example, for some varieties, such as the salmon trout, it has not been possible to realize an adequate commercial offer. Italian consumers appreciate the salmon trout, which is mostly sold fresh. In 2015, due to the difficulty of bringing the freshwater species to commercial size, a lot of product was sold pre-fattened or under the conventional sizes required by the market, with strong implications on turnover. The marine segment, on the other hand, recorded a reduction in volumes sold and turnover in 2015, and continued also in 2016, but these contractions have been linked to natural disasters and loss of biomass (sea storms). The dependence of Italy from abroad continues both in 2015 and in 2016 and the trade balance continues to show a negative growth value (3.5% the variation 2015 vs 2016). Specifically, there was a further increase in imports (+2.5%) and a decrease in exports of fish products of around 4% (ISMEA, 2017). In terms of value, exports in 2016 have maintained prices, while between 2015 and 2016 Italy has spent over 11% more to procure foreign fish products. In 2015 more than 23% of fresh fish were imported, of which about 16% were fish, followed by about 7% molluscs and only 1% crustaceans. In 2016, the composition of the imported fresh product was the same as in 2015, although volumes increased (personal data processing on ISTAT-ISMEA).

Overall industry structure and employment

In the year 2015 the figure recorded over 710 companies, with a remarkable growth compared to 2014 (passing from 587 to 711 companies). In 2015 there were about 46% of companies in multiple groups in the two segments <= 5 employed and 6-10 employed. In 2016, the sector registered a reduction, with a total of 592 companies registered. In 2016 the companies reported decreased as fewer production segments were observed (up to 2015, data were reported and collected for nine production segments, from 2015 the segments were reduced to five, about 50%). The reduction, compared to 2015, involved companies with 6-10 employees (the contraction in 2016 was -36%). In general, however, compared to 2014, the figure is confirmed, the number is consistently increased (1%). Against a reduction of about -33% between companies with 6-10 employees and with 10 employed, the segment of companies with up to 5 employees increased by 16%.

Main segments

According to the move in 2016 to EUMAP, Italy has redistributed and redefined several production segments. Within the framework of the EUMAP, (in agreement with Commission Decision 2016/1251 of the Commission of 12 July 2016, where in Annex 1, Chapter 5, point 5) the segments are 5. This aspect has led to a non-possibility of comparing the total data between 2015 and 2016. Compared to the individual segments, the series will be reported also including the 2016 data, for the segments that have only changed the numbering and label definition. The perfectly equal segments for which a comparison was made are:

- Seg.3.6 SBSB cages (which corresponds to Section 3.4 of the DCF)

- Seg. 10.10 MSS long line (which corresponds to Section 7.2 of the DCF)
- Seg. 12.11 Clam on bottom (which corresponds to Section 9.3 of the DCF).

Main segment referred to volume of production is shellfish (more of 122 thousand tonnes), that has increase around 16% in volume and more than 31% in turnover of sales. The most two species included in the segment "shellfish" are clams - *Tapes philippinarum* - and mussel - *Mytilus galloprovincialis*. In 2016, clams represent 17% of sales and 25% of aquaculture sales. The mussels, however, are confirmed as the first species in terms of both volume (47% of sales in 2016) and turnover, equal to 35% of the entire Italian turnover. Seabass and seabream with cage technology, are produced by the same companies, so the value transmitted and reported both in the DCF and in the data collected under EUMAP concern both species. Specifically, however, starting from 2014-2015, the farms produce over 60% of seabream. Until 2014, production for the two species is almost similar. The production, strongly oriented to consumer preferences, pushes more the production of seabream, both because their price is on average lower than seabass, and in terms of organoleptic, consumers appreciate seabream more.

Current production trends and main drivers (Trends and triggers)

In 2015, consumption of fish products increased by 2.5% compared to 2014, while in 2016 the change recorded a halt which led to a contraction of 1.2% compared to the previous year (Nielsen, ISMEA, 2018). In 2015, consumption of fish products increased by 2.5% compared to 2014, while in 2016 the change recorded a halt which led to a contraction of 1.2% compared to the previous year. Consumption is catalysed on refrigerated, thawed and loose products, and on preserves, but most of the consumption (over 19% of total consumption of fish has been smoked (for 2015) and, in general, processed. A strong setback was recorded in 2016, when the reduction for salted and processed products decreased by 19% compared to 2015. In 2016, the strong decrease in trout consumption was recorded (-12% compared to 2015). This shows that trout has not been a species that consumers could buy because production has been greatly reduced due to environmental disaster related to the strong reduction in water (drought and record temperatures). Among the processed products, in 2016, consumers gave up above all smoked and salted salmon (-15% in 2016) and anchovies, especially salted (-8%). The dependence of Italy from abroad continues both in 2015 and in 2016 the balance of the trade balance continues to show a negative growth value (3.5% the variation 2015 vs 2016). Specifically, there was a further increase in imports (+ 2.5%) and a decrease in exports of fish products of around -4% (ISMEA, 2017). In terms of value, exports in 2016 have maintained prices, while between 2015 and 2016 Italy has spent over 11% more to procure foreign fish products. In 2015 more than 23% of fresh fish were imported, of which about 16% were fish, followed by about 7% from molluscs and only 1% from crustaceans. In 2016, the composition of the imported fresh product was the same as in 2015, although volumes increased (personal data processing on ISTAT-ISMEA). The Italians are counting on consuming fish products, imported mainly refrigerated. In 2016 increased imports of sea bass and sea bream, which together exceeded an increase of 23% in 2016 compared to 2015. Performance increased in 2016 also for salmon (+15.6%), frozen tuna (24%), cod (16.7%). By contrast, mussels were down compared to 2015 (-14.4%). In general, the tendency of Italians is to choose a partly pre-packaged product, especially if imported. Italy imports more from the EU28 (about 584 thousand tonnes for 2015 and just over 485 thousand for the following year). From Extra EU Countries, imports were 423 thousand tonnes in 2015 and 447 thousand tonnes in 2016. 22% (2015) and 21% (2016) of Italian imports compared to the total imported (EU28 plus Extra EU) comes from Spain.

Outlook

The Italian sector expects a growth that, based on forecast analyses, should be about 5% per annum (estimates based on FAO data and on the values reported in the Strategic Plan for Aquaculture (PSA-Italy 2014-2020). The expectations of the freshwater segment are an increase of about 5% compared to 2015 and 2016. For marine species the growth is more sustained, around 2% and equally for mussels and clams. In general, forecasting expectations have been affected by calamitous events (storms, droughts, mussel pathologies). For the future, the expectation is to see a tendency for marine enterprises to push towards sea bream breeding compared to sea bass, estimating a 65-70% share of sea bream and 35-40% of sea bass. For trout it is hoped for greater growth of salmon trout, although in general, the sector does not tend to increase in growth because it cannot hope for the opening of new installations. For the molluscs it is estimated a growth also due to the introduction of the marine protected areas for the exclusive use of mussel farming. Approximately 60% of trout are processed. For marine species diversification concerns only "commercial" aspects that preserve and guarantee special voluntary certifications. Finally, there are no common processing procedures for mussels. In terms of new species, some examples of new species are recalled in the freshwater sector (*Salvelinus fontinalis* which, in 2016, has been about 800 tonnes). The sector, furthermore, push much on the diversification of products offered to consumers. The market supply of freshwater satisfies the external trade, mainly represented from Central Europe market. The monitoring activity of the annual growth is related to the "governance" of the sector: in the last 2 years some cooperatives have jointed in Producers Organizations (POs), in which the aim is to guarantee the level of revenue of the producers, also thanks to introduction local quota, for associates, planning to catch the shellfish. Expectations concern the production of embryonated eggs (trout segment) and fry of marine species. For the freshwater segment, Italy exports both to EU and Peru, Iran and other non-European countries with which it has commercial agreements. For fry of marine species, Italy exports over 5 million fry and the expectation is growing: the number of hatcheries could increase compared to the current 9 (referred only to marine species).

2.3.16 Latvia

Production volume and value

Latvia is a country producing only freshwater aquaculture. The Latvian aquaculture sector produced 779 tonnes of fish and crustaceans in 2016. This production was valued about €2.0 million. The freshwater data collection is not mandatory under the EU-MAP because the total production in Latvia is less than 1% of the total Union production volume and value. However, the economic data collection for some variables has been started from 2014 and new variables were included in the questionnaire form in 2017. The first data for the variables listed in EU-MAP *table 7* were received for 2015 and 2016.

Overall industry structure and employment

Latvia is rich in water resource and has a good location of inland waters and a stable, ecologically pure environment which facilitates the development of aquaculture. For Latvian countryside aquaculture is an important business activity and is the employment provision field. The 85 economically active aquaculture enterprises employed 250 persons in 2016. The aquaculture sector plays noticeable role in the Latvian regions development.

The main activities of the Latvian aquaculture enterprises are the following:

- Artificial breeding of young fish for restocking in coastal seawater and inland freshwater.
- Fish cultivation in freshwater open land ponds and land-based farms in special tanks and growing up for market sale.
- Short term fish cultivation in freshwater ponds for commercial angling.
- Fish cultivation in household ponds for self-consumption or hobby angling.

The aquaculture enterprises are mainly concentrated in the regions of Kurzeme and Vidzeme. A considerable number of agricultural holdings have commenced their business in aquaculture in addition to their other business activity.

Main segments

The data was submitted according to the EU-MAP segmentation in *table 9* “Other freshwater fish Other methods (seg.8.5)”. The segment includes three fish farming techniques: ponds, tanks and raceways and recirculation systems. The main production species are common carp, rainbow trout, northern pike, Crucian carp and tench.

Total number of ponds registered for fish farming and its area were 816 ponds and 4 958 ha (decreased by 3% since 2010) in 2016. There were 1 245 tanks and raceways with the volume of 15 228 m^3 (decreased by 13% since 2010) and 35 recirculation systems with the volume of 5 765 m^3 (increased by eight times in m^3 since 2010) used for aquaculture production in 2016.

Current production trends and main drivers (Trends and triggers)

The number of the economically active aquaculture companies increased by 45 companies between 2010 and 2016. The specific weight of the total number of persons employed in aquaculture has increased from 177 in 2010 to 250 in 2016.

The development of producing aquaculture is largely hindered by the high production costs of the breeding and the problems with the sales of final products. The main item offered at the market – trade size carps during relatively short summer can usually be grown only in the three-summer long cycle with very high production costs. Common carp was the main species produced by the Latvian aquaculture sector representing 73% in weight and 59% in value of the total production in 2016. The sold production volume and value for fish and crustaceans has significantly increased between 2008 and 2016 by 30% and 38%, respectively.

Outlook

The economic data for 2017 will be available in the end of 2018. However, some information was collected for the variables listed in *table 6 Social variables* for fishing and aquaculture sectors. Based on received information it is possible to provide some outlook for 2017.

The social data were analysed in % from the total achieved responses units (21% from the total population). The results show that the 83% from the respondents employed in aquaculture sector were male and the 68% worked in the sector more than six years. Only 4% of the respondents are involved also in small-scale fisheries as a secondary activity. The 69% persons are full-time employed and 82% have indefinite contract. The majority of employees are the citizen of the Republic of Latvia and only 2% of the respondents have another citizenship. 73% of persons employed are older than 40 years. The primary or vocational education comprised 63% of the respondents. The Bachelor and Master degrees were reported by 17% and 13% of the respondents respectively. Only 14% from the total respondents employed in the sector have a different status, such as students (12%), a person with disability (25%) and retired person (63%).

2.3.17 Lithuania

Production volume and value

Lithuanian aquaculture sector in 2016 produced a total of 4.39 thousand tonnes (FAO, 2016) of freshwater fish production from which 4.1 thousand tonnes were destined for consumption (Eurostat, 2016) corresponding to €12.2 million and €10.9 million, respectively. Compared to 2015, the volume of total production decreased by 1.3%, whereas total value increased by 13.6%. Compare to 2008 total volume and value of aquaculture production improved by 46.0% and 84.4% respectively (FAO data).

Overall industry structure and employment

Lithuanian aquaculture sector population in 2016 consisted from 54 enterprises and aquaculture farms. Pond aquaculture units cover the highest share of total production, as 18 enterprises produced around 90% of total national production volume and 86.4% of total value. In 2016 pond aquaculture units employed 359 persons, 4% lower compared to 2015. Another important part of industry includes aquaculture units using RAS (recirculating aquaculture systems). According to 2016 Eurostat data, RAS aquaculture units contributed by 10.6% of total national aquaculture production volume for consumption and 19% of total value of production for consumption. In 2016 RAS aquaculture units employed 141 persons, 37% more compare to 2015. In 2016, national aquaculture sector employed 500 people from whom 388 were males and 112 females. Total number of employees increased by 5.2% compared to 2015.

Main species produced

In 2016 the most important species in terms of volume and value were carps from pond aquaculture. Carp production accounted for 3.47 thousand tonnes in 2016 and compared to 2015, decreased by 5.28%, whereas 23.1% of growth was observed compared to 2008. Around 70% of total carp production was sold in Lithuania and 91.2% of it for consumption. Carps are usually grown in polyculture with other cyprinids as bighead carp, white amur, tench and other freshwater species as European pike and European catfish. Therefore, other freshwater species significantly contribute to the total aquaculture production.

The second most important species is rainbow trout with a production of 331.9 thousand tonnes in 2016 corresponding to value of €1.12 million. Trout production contributed to 7.8% of total volume and 9.1% of total value on national aquaculture production in 2016. Compared to 2015, rainbow trout production volume and value improved by 19.4% and 12.3% respectively. The vast majority of production comes from RAS.

African catfish is one of the main species produced in the small scale RAS units. In 2016 African catfish production was 119 t corresponding to €384.9 thousand value.

In 2016, aquaculture farms produced 126.6 tonnes of sturgeons, compared to 2015 production raised by 39.7% and compare to 2008 it increased by around 7.5 times.

Current production trends and main drivers (Trends and triggers)

From 2008 to 2014 total aquaculture production increased by 46.0%. The main drivers affecting aquaculture growth were increasing trends of fish consumption at national level, while export volumes did not show an increasing tendency. Increased investments had the significant impact on sector, by rising aquaculture production capacity through construction of new RAS farms, modernisation of existing pond infrastructure and diversification of products by processing their own aquaculture production.

Outlook

According 2017 data (AIRBC), volume of aquaculture production decreased by around 15%, whereas value had only a modest decline of 1%. Deterioration of pond aquaculture was driven by extremely bad climate conditions in 2017 when the level of average temperature in the growing season was too low for the growth of cyprinids and excessive rain during growing season increased water level in rivers which did not allow a proper harvesting of pond production. RAS production decline was related to the unexpected closure of business of the main large scale trout producers in 2017 and 2018. Further decline in the exports warns the retaining of continuously improving aquaculture production trend. However, if aquaculture producers will be able to further increase production of higher value products from, eel, sturgeon, trout and catfish production by adding value with processing and at the same time will break through declining export trend, growth of production volume and value will likely continue.

2.3.18 Malta

Production volume and value

The Maltese aquaculture industry is solely based on marine fish. In 2015 and 2016 respectively, 10 800 tonnes and 13 656 tonnes of marine fish were produced by the sector. From 2014, production increased by 59% (5 056 tonnes). In parallel, the turnover generated by the sector also registered significant increases: In 2015, sales amounted to €127.9 million which corresponds circa, to a 32% increase. Furthermore, since production increased by 26% between 2015 and 2016, sales also increased. In 2016 turnover amounted to €164 million, which corresponds to a 28% increase from the previous year.

Overall industry structure and employment

Six aquaculture enterprises operated in 2014. Only one enterprise had less than five employees and the remaining employed more than 10 persons. This structure has remained relatively stable over the past seven years. The number of employees decreased from the previous year (2013) by 13%, whereas fulltime equivalents decreased by 14%. Male employees accounted for 96% of total employment. The average wage returned to similar values as in previous year and recuperated from the declining values obtained in the two preceding years.

Six aquaculture enterprises operated in 2015 and 2016. Similarly, to the past eight years, in 2015 only one enterprise out of the six in the sector had less than 5 employees as the remaining participants employed more than 10 persons. In 2016 however, out of the six operating enterprises, two employed less than 5 personnel and 4 employed more than 10. This change though did not translate to a drop in the number of employed individuals in the sector as from 2014; employment has been gradually increasing each year. Compared to the year prior, in 2015 employment increased by 8%, whereas in 2016 employment increased by 15%. 2016 registered the highest number of employment with 224 employees since 2008. In 2015, the average wage decline by 11% when compared to the year prior, this declining trend continued further as average wage dropped by another 17% in 2016. This decline could be partly deriving from the fact that employment in each of the above-mentioned years recorded increases as well.

Main segments

The aquaculture industry in Malta is marine-based. The greatest portion of production and value is mainly attributed to the capture-based aquaculture for Atlantic bluefin tuna. Following this, other important segments include the culture of European seabass and Gilthead seabream, brown meagre and amberjack.

On a regional scale, Malta attributes for a very low proportion in hatcheries and nurseries, and low volumes of seabass and seabream and other species except for bluefin tuna. Bluefin tuna fattening attributes for a significant share in the Mediterranean.

2.3.19 Netherlands

Production volume and value

The Dutch aquaculture sector produced a total of 56.5 thousand tonnes of shellfish in 2016, which corresponded to a decrease of 1% from 2016 to 2015. The total production value was around €60 million in 2016, when it was €70 million in 2015. Compared to the average for the years 2011-2015, the total volume of shellfish increased by 17%, whereas the total value decreased by 14%. Figures for finfish were not available.

Overall industry structure and employment

In 2016, the total population of mussel and oyster aquaculture farms was 70, distributed over mussel production (51 companies) and oyster production (19 companies) The Dutch aquaculture sector is dominated by small enterprises with less than 5 employees. Figures for finfish were not available.

Main segments

The production in the Netherlands can be divided into three main segments. The largest segment is the production of blue mussels on bottom cultures. The second most important segment is the production of oysters. Third is land-based production of finfish, mostly eel and catfish.

Current production trends and main drivers (Trends and triggers)

2016 showed a slight decrease in mussel production, due to the existence of tetrodotoxine in the Oosterschelde waters. Part of the harvest could not be sold. A growing amount of mussel seed comes from the so called mussel seed collectors.

Oyster production is relatively good at the moment, although the enterprises have to cope with the effects of the Japanese oyster drill and the Herpes virus.

Outlook

Based on the currently available data, it is expected that the mussel sector will show a good performance in the coming years as supply of mussel seed was relatively high in the last years. The oyster farmers are experimenting with grow tables. Oysters are grown off the bottom on these tables to avoid the negative effects of the Japanese oyster drill.

2.3.20 Poland

Aquaculture in Poland is part of the inland fisheries sector and consists exclusively of the rearing and culture of freshwater fish, primarily carp and trout. In addition to aquaculture activities, inland fisheries comprise commercial lake and river fisheries, as well as recreational angling in inland waters.

In addition to the production of fish for consumption, Polish aquaculture produces stocking material for migratory (anadromous), rheophilous and predatory fish. The rising demand noted in recent years for this type of material has provided an impetus for the development of fish farms and the modernization of hatcheries and rearing facilities.

Most of the fish produced by Polish aquaculture supplies the domestic market. The principle fish for export is rainbow trout, goes primarily to Germany. Nearly all the trout exported is processed. Carp exports remains low.

In 2016, the total volume of Polish aquaculture production was 38.3 thousand tonnes (FAO 2018) of which 35.5 thousand tonnes were destined for consumption (Eurostat 2018) corresponding to €109.6 and €91.5 million respectively. Increases have been noted in freshwater aquaculture production due to increased trout production and stabilized carp catches.

The total number of persons employed in the sector was 6344 and it decreased by 12% compared to 2015. The sector is operated by professionally trained personnel. There is a well-developed education system for fisheries and aquaculture.

The biggest sector is the production of carp. In 2016 common carp stood for 49% of the total volume of production and for 43% of the total value. The volume of production of common carp increased to 17.4 thousand tonnes (about 7%) and to the value of €39.6 million (about 10%).

Second biggest aquaculture sector is rainbow trout, which contributed 39% of the total volume of production and 43% of the total value. In 2016, production of rainbow trout increased to 13.7 thousand tonnes (about 7%) and the total value was €38.9 million, which corresponds to an increase of 8%.

A new segment of aquaculture has been dynamically developing, specializing in the production of fish eggs intended for consumption, including the most valuable caviar of sturgeon fish. In 2016, the production of eggs for consumption reached a record weight of 18.8 tonnes, of which the most valuable sturgeon caviar accounted for 87.3% of total production.

2.3.21 Portugal

In total, the Portuguese aquaculture sector produced and sold around 10.2 thousand tonnes in 2016, which corresponded to an increase of 4% from 2015 to 2016. The total value of the production was €73.7 million, which corresponded and an increase in value of 20% over the same period. From 2008 to 2016, the total sales volume increased by 48%, whereas in total value increased by 80%.

A peak of production was verified in 2012 (10 401 tonnes), with a break in 2013 (7 080 tonnes). However, there has been a recovery in the volume of production, currently at a level almost identical to that of 2012, with a total volume of 10 022 tonnes.

Overall industry structure and employment

In 2016, the sector comprised 1 402 farms that employed 2 650 workers, of which 534 were women and 2 117 were men; proportion of 1:4. The sector is dominated by small enterprises, 95% of the Portuguese enterprises had less than 5 employees in 2016.

Main segments

The sales volume in brackish and marine waters remained the most important, accounting for about 93% of total production. The volume of fish in brackish and marine waters, in turn, represented 37.6% of total sales, and from those, 87% corresponded just to the production of sea bream and turbot. However, the production of marine fish has decreased 24% from 2015 to 2016. This is explained essentially by the decrease in the production of the main species. In fact, in comparison to the previous year, turbot (2 222 tonnes), which represents 58% of sales volume of marine fish, decreased 35% in volume.

The production in terms of turnover can be distributed into four main segments. The most important (in terms of production weight and value) is the production of clams (*grooved carpet shell*) on bottom (small areas of land in intertidal zone, usually with less than 1 hectare).

The second most important segment is the production of other marine fish on growing namely, turbot and sole. The production techniques used are tanks and recirculation systems.

The third segment is the production of sea bass and sea bream on growing in ponds and cages.

The fourth segment is the production of oyster off bottom culture in intertidal zones, normally using bags and tables, and in the sea using Chinese lanterns in long lines.

Current production trends and main drivers (Trends and triggers)

Portugal, having natural conditions, despite some limitations, is suitable to the development of this activity. It dominates in the production technology of susceptible species to fill important markets and considers the development of the aquaculture sector a national priority as means to satisfy the demand for fish while ensuring the maintenance of a production chain that provides increased national wealth, promotes employment and helps to reduce the pressure on the resources in fishing grounds.

In the autonomous region of Madeira, the growth of the sector will follow the current model of fish production in open sea, more adapted to the conditions of the environment, as well as promote the diversification of the species.

In the autonomous region of the Azores, the biological characteristics of the waters advise the implementation of a cultivation regime that takes into account its specificities, both in the installation and in the exploration of aquaculture production units in the region. The strategy for sustainable development in this region is based on an activity that offers quality products, in limited quantities and with the lowest possible impact on the environment.

Portugal is not self-sufficient in aquaculture produce, namely in sea bass and sea bream, and so, there is a dependency on imports to supply markets.

The foreign market for organic mussels continues to be the principal destination of sales.

Employment in the turbot sector remains steady. The oyster sector continues to grow in production volume, value and employment.

Outlook

An increase in production is expected due to new production farms for mussels and oysters, and also due to the contribution of the production of a new farm for sole.

In terms of progress, the regulatory frame has changed recently, and the simplification of administrative procedures is on track to create new areas for aquaculture production. Co-financed investments to enhance competitiveness have only recently been approved and will require multiannual implementation.

The outlook for the increase of overall value is good. Looking forward to direct selling of shellfish products into new, high end markets occurring for oysters, and at the same time, mussel from biological production are beginning to benefit from new markets in the EU.

2.3.22 Romania

According to FAO data, the Romanian aquaculture sector produced 12 554 tonnes in 2016 which corresponded to an increase of 12% from 2015 to 2016.

The main species produced by the sector, according to FAO, are common carp, silver carp, bighead carp and rainbow trout with reported volume of production 4 841, 2 364, 2 121 and 1 109 tonnes respectively in 2016.

2.3.23 Slovakia

The Slovakian aquaculture production consisted of 1 957 tonnes in 2016, solely from freshwater species and reached the highest level since 2008, reaching €4.9 million.

Rainbow trout was the main species produced by the sector, representing 55% in total volume and 67% of total value of sector production. Followed by other freshwater fishes, such as common carp and silver carp.

2.3.24 Slovenia

Production volume and value

Aquaculture in Slovenia comprises freshwater aquaculture (cold-water fish farming of salmonids and warm-water fish farming of cyprinids) and mariculture (fish and shellfish farming). The major species contributing most of the production value in freshwater fish farming are rainbow trout (*Oncorhynchus mykiss*) and common carp (*Cyprinus carpio*), whilst in mariculture it is Mediterranean mussel (*Mytilus galloprovincialis*) and European seabass (*Dicentrarchus labrax*).

For the DCF, Slovenia collects data on marine aquaculture, not for the freshwater segments. Hence, in this chapter all data refers only to marine (fish and shellfish) aquaculture.

In 2015 the marine aquaculture turnover was €771 335, in 2016 the same turnover increased by almost 12% and amounted to €860 413. The total sales volume also increased by 5% from 2015 to 2016 and was 643 tonnes in 2015 and 675 tonnes in 2016.

Overall industry structure and employment

In 2016, there were six companies with five or less employees and one company with six to ten employees. The status in employment reflects the situation in the aquaculture sector whereby the majority of small family farms operate with self-employed people, mostly one employee. Total employment in 2016 was estimated at 20 jobs, corresponding to 19.6 FTEs. The level of employment decreased between 2008 and 2016, with total employed decreasing by 31% while the numbers of FTEs decrease by 26% over the period. With respect to the gender, men predominate the aquaculture sector workforce. In 2016 eight women (40%) were involved. Average salary per FTE employees in 2008 was €21 513. In 2016 average salary per FTE employees decrease by approximately 56% compared to 2008 and amounted €9 492.

Main segments

They are two main segments in the Slovenian marine aquaculture sector; sea bass & sea bream cages (seg3.4) and mussel rafts (seg7.1). The most important species are Mediterranean mussel and European seabass.

In terms of sales volume mariculture shellfish farming are more important than fish farming. Shellfish farming accounted for 96% of total sales volume in 2016. The production of European seabass contributed around 4% to total mariculture production in 2016.

Current production trends and main drivers (Trends and triggers)

Regarding techniques and species all marine segments are very homogeneous. Marine fish farming practice is normally intensive and takes place in floating platforms where the cages are submerged into the sea. They produced mostly European seabass. Shellfish farming practice is extensive and takes place in lines of floating buoys linked together, where longlines with mussels are suspended.

Outlook

Future development of mariculture is strongly conditioned by the small size of the Slovenian Sea. In 2007, three larger areas were designated for marine aquaculture in territorial waters that were subsequently separated into 22 plots, for which concessions were granted for the use of marine water in 2009. It is expected that these plots will not be able to expand, due to the use of Slovenian territorial waters for other purposes. All Slovenian maritime fish and shellfish farms are currently operating at about 60% of their capacity. In the future we can expect increasing production to maximum capacity and then stagnation of the sector.

On the other hand, because of the good quality and quantity of inland water, Slovenia has a good chance to increase freshwater aquaculture, particularly salmonid rearing such as rainbow trout, Huchen (*Hucho hucho*) and brown trout. Today there are in about 60 trout farms, with a total production of only about 800 tonnes per year.

2.3.25 Spain

The Spanish aquaculture sector produced 295 173 tonnes of fish, fry and shellfish in 2016. Due to natural conditions, one of the main features of the Spanish aquaculture is diversity, with marine products, fish, molluscs, algae and freshwater species. In 2016, aquaculture industry recorded the highest production value in all the period considered, when production generated €626 million and the sector had a total income of €650 million, representing a 31% increase over the years from 2008.

Overall industry structure and employment

Aquaculture in Spain has a significant role in the economic and social development in certain areas. Spanish aquaculture structure is based in small units, with a number of 2 290 in 2016. The number of employees amounted to 17 811, as a result of a negative trend during 2015 and 2016. Nevertheless, while the number of employees in 2016 is lower than the average in previous years, the number of FTEs is higher. This indicates a positive trend of the employment and its stability in the middle-long term.

Main segments

Seabass & Seabream cages: Seabass and seabream are the main species in the Spanish aquaculture in terms of value. The production in cages generated 32 879 tonnes, valued almost €239 million in 2016. This segment has experienced an improvement in its economic performance indicators since 2012 from negative to positive economic returns.

Other marine fish in cages: This segment mainly consists in the fattening of Atlantic bluefin tuna in cages, which has shown an extraordinary increase in production and profits despite the fall of prices at the destination markets due to an increase in supply. This segment also shows the lower labour rotation rate contributing to the creation of long term and stable employment.

Mussel rafts: The mussel production in represented 73% of the total Spanish aquaculture production in terms of quantities and 18.8% of the value in 2016. The production value of this segment was 118 million in 2016, the highest production value during whole period analysed. This is the biggest segment in terms of employment, with 2 610 FTE in 2016.

Trout combine: Trout represents the freshwater aquaculture production in Spain. In 2016, trout segment economic indicators have worsened compared to previous years, and this farming activity obtained negative economic returns on investments.

Current production trends and main drivers (Trends and triggers)

The production of the Spanish aquaculture industry continued to increase in 2015 and 2016 to then level off. This trend is extensive to the main segments and indicators. The trend of substitution of small companies by larger observed in previous years persists and the number of FTE continues to raise. Overall, net profit increased in the last two years suggesting improved efficiency. However, significant differences exist by segments.

Outlook

Current trends in Spanish aquaculture are driven by the strategic guidelines provided by the Commission in April 2013, which is described in the pluriannual strategic plan. The guidelines prioritize four pillars: simplification of administrative procedures for new fish farms, the coordinated spatial planning to overcome negative effects of the lack of space, strengthening the competitiveness of EU aquaculture and the promotion of fair competition.

2.3.26 Sweden

Production volume and value

Over the years 1998 to 2016 production levels have increased from 8 200 tonnes in 2008 to 16 600 tonnes in 2016 and the value of total production have increased from €14.5 million in 2008 to €58.6 million in 2016. The change in production levels between 2015 and 2016 is an increase by 25%, which corresponds to a total increase in value of 10%.

Overall industry structure and employment

In 2016, the total population of aquaculture farms was around 300, which was distributed on 136 enterprises. The Swedish aquaculture sector is dominated by small enterprises, and in 2016 85% of the Swedish enterprises had less than 5 employees.

Main segments

The aquaculture sector in Sweden is divided into seven segments from 2016 and onwards according to the EUMAP. However, these segments are aggregated to be able to follow the development over time and link the data to previous segmentation. Other freshwater fish in cages for consumption is the most common production in Sweden. Rainbow trout is the most important specie with respect to both weight and value. Fish produced in cages are common both in freshwater and in coastal waters, although fish in freshwater are dominating. The average size of a cage is 1 400 m3. Other production methods, such as ponds and raceways are mainly used for producing fish for stocking.

Current production trends and main drivers (Trends and triggers)

The Swedish aquaculture sector has experienced an increase in the volume of production over time. The growth of Swedish aquaculture has been positive in the 2000s. However, the growth in the sector stalled in 2012, and production decreased in 2014 and 2015 but recovered in 2016 with a 25% increase. Exports of fresh, chilled or frozen fish are mainly to other European countries, especially Finland and the Baltic countries.

Outlook

The significantly higher net import than net export still implies a positive development for the Swedish aquaculture farmer. However, in the last years several farms have been denied new or increased environmental licenses due to new interpretations of the environmental legislation. These forces the industry to change to more environmentally friendly methods in the future. Another difficulty facing the Swedish aquaculture sector is related to regulations and administration. In an attempt to alleviate these difficulties, an investigation on how to adapt regulations and simplify administration will be conducted in 2019.

2.3.27 United Kingdom

Production volume and value

In 2015, the total reported UK aquaculture sales weight was 211 756 tonnes valued at €999 million. In 2016, sales weight decreased to 194 507 tonnes, but value increased to 1 023 million. Salmon continues to dominate by both sales weight (ca 83%) and value (ca 90%). Since 2008, there has been a greater increase in imputed value (+54%) than sales weight (+5%).

Overall industry structure and employment

The UK aquaculture industry is diverse reporting production from 9 segments, across seawater and freshwater. A variety of finfish and shellfish species are produced for direct consumption, as functional species (cleaner fish), restocking fisheries, and the ornamental (pet) trade. In 2016, UK aquaculture employed 3 285 people: the salmon segment employed the majority (56%), with the trout (17%), mussel (9%) and oyster (9%) segments being other major employers. In 2016, 473 authorised aquaculture enterprises operated in the UK – the majority (83%) were small (≤5 employees), and only 7% employed >10 people. Five large (multinational) salmon companies are responsible for much of the UK aquaculture production.

Main segments

Recorded UK aquaculture production tonnage and imputed value was largely attributable to three main segments: Atlantic salmon, mussels and rainbow trout.

- Salmon dominated production tonnage (ca 83%) and value (ca 90%). The salmon segment combined hatcheries and nurseries with seawater net-pen production to harvest.
- Mussel was the second most important segment by tonnage (8% of total), but third by value (2% of total) due to a lower unit value. In the UK, mussels were grown on the sea-bed and suspended systems.
- The volume of trout produced (7% of total) was lower than that of mussels, but was of a higher value (5% of total). Rainbow trout (harvested from both freshwater and marine systems) dominated the segment.

Current production trends and main drivers (Trends and triggers)

Salmon: Production tonnage decreased in 2015 (-4%) and 2016 (-5%), reversing the long-term upward trend from 2008. This decrease has been attributed to mortality or early harvest due to disease (sea-lice, amoebic gill disease) and plankton (jellyfish, harmful algal blooms) issues. However, a large increase (+16%) has already been reported for 2017, to the highest ever level of UK production recorded.

Mussels: Mussel production fell again, continuing the negative trend to a 61% fall in production tonnage since the 2008 peak. The trend is expected to reverse in coming years if new off-shore long-line sites start harvesting.

Trout: UK trout production increased by 13% in 2015/16 after a previous stable period (2011-2014). The trend for decreasing production (of portion size fish) from freshwater sites is being offset by increased production (of large trout) from seawater.

Outlook

UK aquaculture production is expected to increase markedly in 2017 due to a 16.5% increase in Scottish salmon harvest. However, this increase may be a temporary spike, as 2018 Scottish salmon production is currently projected to fall. The potential impacts of Brexit are unknown.

3 The Structure of the EU Aquaculture Sector

In 2016, marine fishes, freshwater fishes and shellfish accounted for 31%, 22% and 47% of the EU production of aquaculture in terms of weight, respectively. In value terms, marine fishes, freshwater fishes and shellfish accounted for 55%, 21% and 23% of the production value (Figure 3.1).

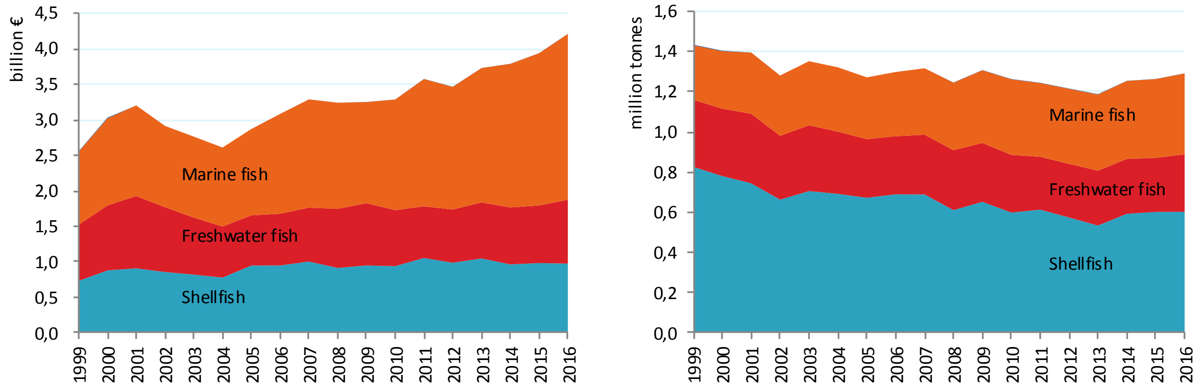


Figure 3.1: EU (28) aquaculture production in weight and value by subsector: 1999-2016.
Source: Own elaboration from FAO, 2018

Given that not all Member States report the economic indicators of their aquacultures sector, the EWG performed some estimations of total EU sales and economic performance[3]. Figure 3.2 shows the total sales and total income from both the DCF/EUMAP reporting and the estimates for EU 28 in 2016. The total sales obtained from DCF/EUMAP were €1 245 million, whereas the estimated sales value was €1 422. The total income reported under DCF/EUMAP was €4 283 million, whereas the estimated income was €4 893. The main difference is found in the freshwater sector due to the fact that reporting of freshwater activities is not mandatory under the DCF or EU MAP.

The estimates for total sales and income were calculated on the basis of alternative sources (e.g. EUROSTAT and FAO). However, most economic variables are only available from the DCF/EUMAP data collection and not from those alternative sources. Therefore, the rest of this chapter focuses on DCF/EUMAP data. This being said, the DCF/EUMAP data represent 87.5% of the EU total (both in terms of value and total income) and therefore they can provide a good approximation of the overall EU aquaculture performance.

[3] For further details, see sections 3 and 5 in the Annex on data coverage and on how the estimates have been calculated.

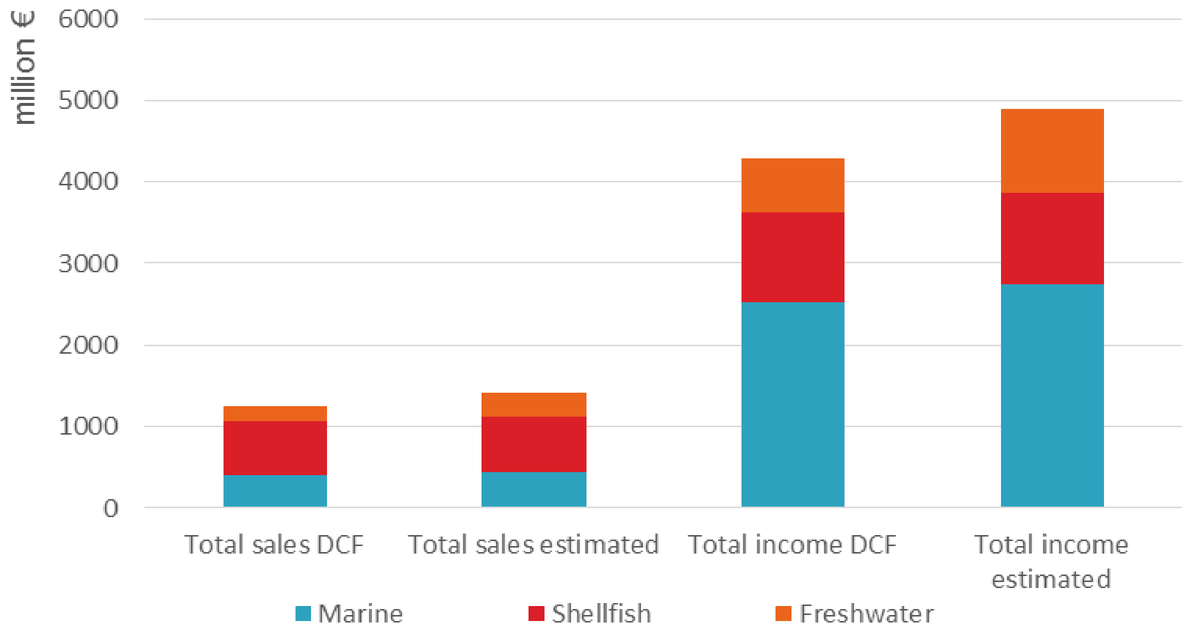


Figure 3.2: EU Aquaculture sales and total income by subsector: 2016.
Source: EU Member States DCF data submission, 2018 and estimation by the EWG.

Figure 3.3 shows that income in the EU aquaculture sector is mainly generated in the marine sector (€2 526 million, 59% of the total) followed by the shellfish sector (€1 107 million, 26%) and the freshwater sector (€650 million).

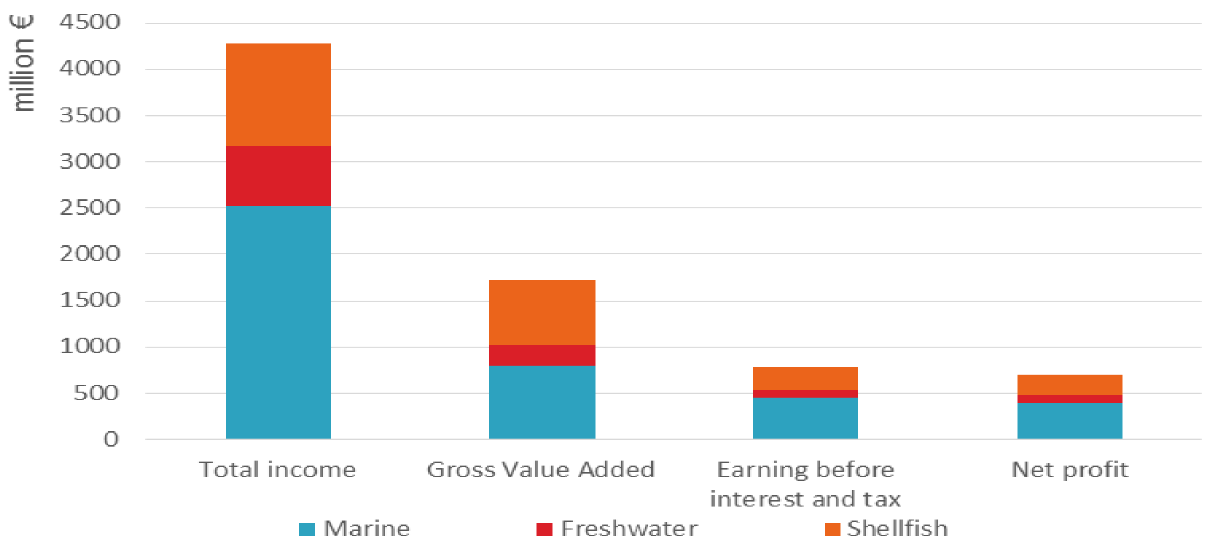


Figure 3.3: EU Aquaculture economic performance by subsector: 2016.
Source: EU Member States DCF data submission, 2018

Most of the GVA is generated in the marine sector (€799 million, 46% of the total) followed by the shellfish sector (€700 million, 41%) and the freshwater sector (€220 million, 13%). EBIT is mainly generated in the marine sector (€446 million, 57% of the total) followed by the shellfish sector (€250 million, 32%) and the freshwater sector (€92 million, 12%). Net profit are mainly generated in the marine sector (€400 million, 57%), followed by the shellfish sector (€225 million, 32%) and the freshwater sector (€80 million, 11%). Therefore, the shellfish sector tends to generate higher GVA and benefits in relative to the income than the other two sectors.

Main species in the EU aquaculture

In 2016, according to FAO data, the production volume by specie for the EU aquaculture was 1.3 million tonnes. The main aquaculture species produced were sea mussels nei (mostly consisting of Mediterranean mussels) (220 thousand tonnes, 17% of total EU production), rainbow trout (185 thousand tonnes, 14%), Atlantic salmon (181 thousand tonnes, 14%), blue mussels (153 thousand tonnes, 12%), Mediterranean mussels (103 thousand tonnes, 8%), gilthead seabream (83 thousand tonnes, 6%), European seabass (81 thousand tonnes, 6%), Pacific cupped oysters (75 thousand tonnes, 6%) and common carp (73 thousand tonnes, 6%). These nine species account for almost 90% of the total EU aquaculture production in weight.

We observe a certain specialisation in the production across countries. The major shellfish producers were Spain, France and Portugal and Italy. Atlantic salmon was mostly produced in the United Kingdom. Pacific cupped oysters were mostly produced in France, whereas Rainbow trout was produced mainly in Denmark, France and Spain.

In 2016, the main aquaculture species produced in value were Atlantic salmon (€1 047 million, 25% of total EU value), rainbow trout (€615 million, 15%), European seabass (€502 million, 12%), gilthead seabream (€445 million, 10%) and Pacific cupped oysters (€370 million, 9%). These five species accounted for 71% of the total EU28 aquaculture production in value.

Figure 3.3: Main species produced in EU aquaculture: 2016.
Source: FAO, 2018

3.1 Marine aquaculture

Fish production in marine aquaculture is characterised by being capital intensive, in the sense that relative large investment is needed on physical equipment and stoking of cages compared to the input of labour. The labour productivity in the sea cage farms is high compared to other EU aquaculture segments.

The total sales volume for the EU28 marine aquaculture sector is estimated to be 425 thousand tonnes and the total value of sales (turnover) is estimated to be €2.67 billion in 2016, corresponding to a 19% increase compared to 2015. Available data report 598 enterprises in the marine sector in 2016. Employment reached 9 614 employees and 8 206 FTEs. Most employees in the marine sector were working full time. On average, the enterprises had 16 employees.

The average wage for the EU marine aquaculture sector was €30.7 thousand in 2016, with a significant variability across countries (e.g. from €4.3 thousand in Slovenia to €55.3 thousand in Denmark). This variability can be explained by differences in labour productivity and the capital and production intensity of the different techniques.

Table 3.1: Economic indicators for the EU marine aquaculture: 2016.

Country	Number of enterprises	Total sales volume	Turnover	Employment	FTE	Average wage
	number	*thousand tonnes*	*million €*	*number*	*number*	*thousand €*
Croatia	27	12.5	99.3	1,029	988	16.1
Denmark	5	12.6	62.4	150	100	55.3
Greece	329	107.1	562.6	3,111	2,676	19.0
Ireland	20	16.7	106.0	180	160	36.9
Italy	46	11.7	84.6	374		
Malta	5	13.6	163.1	221	221	17.1
Portugal	34	3.8	29.4	257	245	17.0
Slovenia	1	0.0	0.1	9	9	4.3
Spain	79	57.0	481.7	2,379	1,958	39.7
United Kingdom	52	163.2	937.2	1,904	1,756	48.3
Total reported	***598***	***398.3***	***2,526.5***	***9,614***	***8,206***	***31.0***
Others		26.3	138.5			
Total EU		**424.7**	**2,665.0**			

* Italian data on FTE and on average wage are not reported as the EWG considers them to be unreliable.
Source: EU Member States DCF data submission 2018 and FAO

The marine sector provided €799.1 million in GVA which was 51% higher compared to 2015. EBIT increased by 345% reaching €446 million, mainly due to the good economic performance of the Greek, Spanish and Croatian marine sectors. ROI reached 13.8% in 2016 and labour productivity increased to €78 500.

Table 3.2: Economic Performance indicators for the EU marine aquaculture: 2016.

Country	GVA	EBIT	ROI	Labour productivity	Capital productivity	Future Expectations Indicator
	million €	*million €*	*%*	*thousand €*	*%*	*%*
Croatia	35.7	15.4	5.9	36.1	13.6	2.5
Denmark	14.6	7.2	16.5	145.6	33.4	-1.8
Greece	193.8	135.8	12.7	72.4	18.1	0.1
Ireland	30.7	24.8	32.5	192.5	40.4	2.7
Italy	44.1	28.4	23.1		35.8	18.9
Malta	18.2	13.1	50.1	82.2	69.7	0.8
Portugal	43.3	30.1	52.4	176.9	75.3	23.1
Slovenia	0.3	0.2	8.3	28.2	11.8	-1.7
Spain	163.4	72.0	50.1	83.5	29.8	0.1
United Kingdom	255.1	119.0	14.6	145.3	31.2	4.0
Total EU	799.1	445.9	13.8	78.5	23.4	1.1

* Italian data on labour productivity are not reported as the EWG considers them to be unreliable.
Source: EU Member States DCF data submission, 2018

The most produced marine species in terms of sales volume was Atlantic salmon representing 45% followed by gilthead seabream (21%) and European seabass (20%). In terms of total sales value Atlantic salmon represented 45% followed by European seabass (22%) and gilthead seabream (19%).

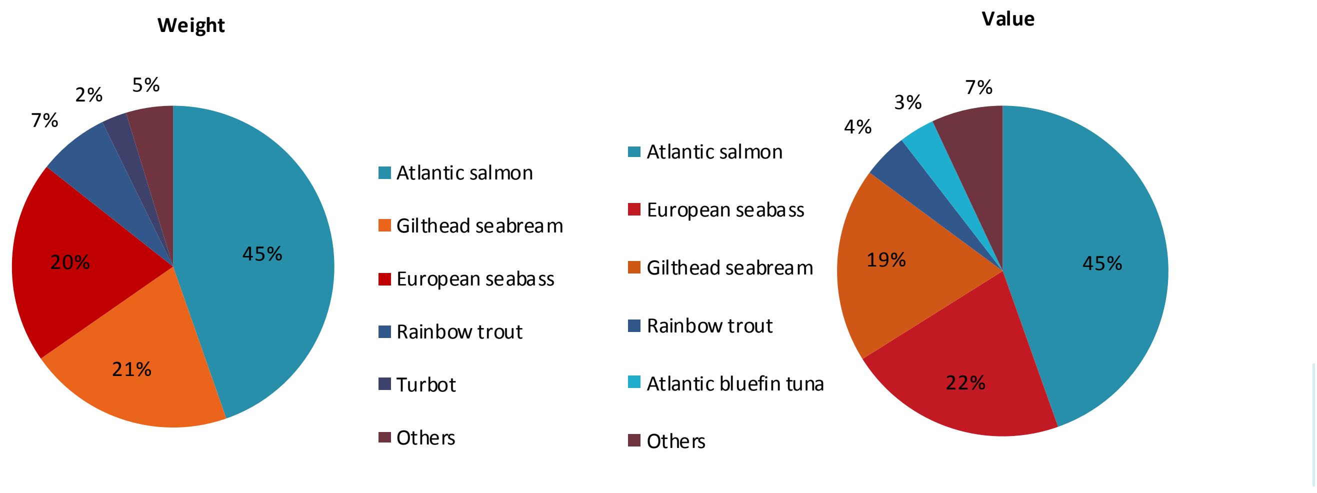


Figure 3.4: Main species produced in the EU marine aquaculture: 2016.
Source: FAO, 2018

3.1.1 *Salmon*

According to FAO Statistics for 2015[4]: the main salmon species farmed world-wide and in the EU is Atlantic salmon (*Salmo salar*); minor farmed production of coho salmon (*Oncorhynchus kisutch*) and chinook salmon (*Oncorhynchus tshawytscha*) occurs outside the EU; the global production of farmed Atlantic salmon in 2015 was 2.4 million tonnes, valued at 11.9 billion USD (€13.2 billion); Norway was the world's leading producer (55% of global volume) followed by

[4] http://www.fao.org//fishery/static/Yearbook/YB2015_CD_Master/root/aquaculture/b23.pdf

Chile (26%); the EU (UK, Ireland, Denmark, France, Sweden, Spain) produced 7.8% of global farmed Atlantic salmon tonnage.

According to DCF data: the EU produced 180 000 tonnes of salmon, valued at €1 044.8 million in 2016; the only two producing countries were the United Kingdom (163 135 tonnes, 91%) and Ireland (16 900 tonnes, 9%). Spain reported salmon enterprises, but no production.

The FAO salmon production data for 2015 indicate additional EU salmon production in Denmark (428 tonnes), France (300 tonnes), and Spain (8 tonnes). Eurostat data (for 2015 and 2016) similarly reports salmon production in Denmark (420 and 1 279 tonnes), Poland (4 and 272 tonnes) and Spain (8 and 5 tonnes). The apparent disparities may reflect exclusion from DCF/EUMap for reasons of confidentiality, production below DCF thresholds, non-commercial production, and/or accounting in other (non-Salmon) segments (and/or incorrect coding within databases).

The main indicators for EU Atlantic salmon aquaculture collated under the DCF are presented below. EU figures largely reflect the dominant UK industry: the UK is the main EU producer of Atlantic salmon with 91% of the production by weight and 90% by value. The UK also provides the greatest employment: 1 691 FTEs and 1 833 employees in 2016. The average annual wage in salmon aquaculture in the UK was €50 200. The other producer was Ireland with 9% of the total production volume, 206 employees, 179 FTE and a lower average annual wage of €40 500.

Table 3.3: Economic indicators for EU salmon aquaculture: 2016.

Country	Number of enterprises	Total sales volume	Turnover	Employment	FTE	Average wage
	number	*thousand tonnes*	*million €*	*number*	*number*	*thousand €*
Ireland	28 ▲	16.9 ▲	108.6 ▲	206 ▲	179 ▲	40.5 ▼
Spain	4 ▼	0.0 ▼	0.0 ▲	19 ▼	16 ▼	16.6 ▼
United Kingdom	40 ▼	163.1 ▼	936.1 ▲	1,833 ▲	1,691 ▲	50.2 ▼
Total reported	***64*** ▼	***180.0*** ▼	***1,044.8*** ▲	***2,058*** ▲	***1,886*** ▲	***50.2*** ▼
Other none DCF		0.3 ▭	1.5 ▭			
Total EU		**180.3** ▼	**1,046.3** ▲			

Source: EU Member States DCF-EUMAP data submissions and FAO, 2018

The salmon segment of EU aquaculture employed 2 058 persons in 2016. Part-time work is minor, since the ratio between employment measured in full time equivalents (FTE) and total employment was 92% in 2016.

The Figure below shows a time series of economic performance indicators for salmon aquaculture (all segments) for 2012-2016. These largely reflect the figures submitted for the UK salmon industry. Total operating costs show an increasing trend. Net profit margin increased over the period 2012-2014, reduced in 2015 and recovered somewhat in 2016.

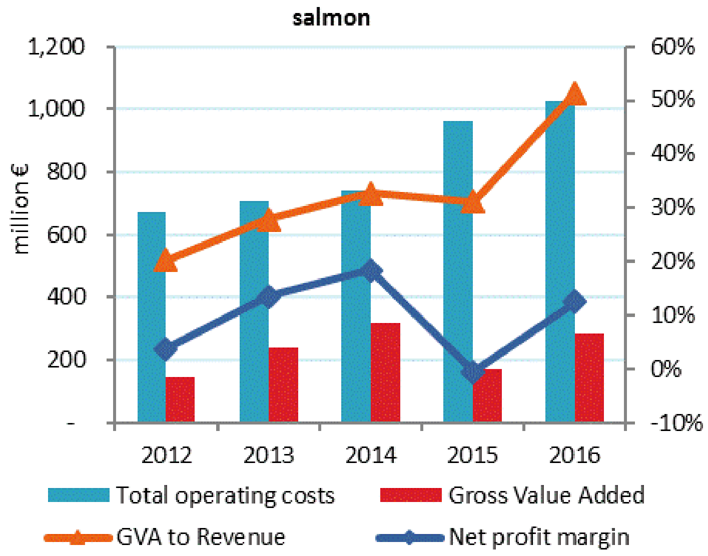


Figure 3.5: Economic performance indicators for salmon aquaculture: 2012-2016.
Source: EU Member States DCF-EUMAP data submissions, 2018

In 2016, EU salmon aquaculture produced a Gross Value Added (GVA) of €254.8 million and an EBIT (earnings before interest and tax) of €117 million. The ROI (return on investment) was 14.2%. Labour productivity was €149 000 per FTE. The capital productivity was 30.9%, and the Future Expectations indicator was 3.9%.

Table 3.4: Economic performance indicators for EU salmon aquaculture: 2016.

Country	GVA	EBIT	ROI	Labour productivity	Capital productivity	Future Expectations Indicator
	million €	*million €*	*%*	*thousand €*	*%*	*%*
Ireland	0.8 ▲	-0.6 ▲	-8.0 ▲	39.4 ▲	9.6 ▼	-0.8 ▼
United Kingdom	254.0 ▲	117.9 ▼	14.4 ▼	150.2 ▲	31.1 ▲	4.0 ▲
Total EU	254.8 ▲	117.3 ▼	14.2 ▼	149.0 ▲	30.9 ▲	3.9 ▲

Source: EU Member States DCF-EUMAP data submissions, 2018

The most important costs to the EU salmon aquaculture sector are feed costs (39% of total costs). Other operational costs constitute the next highest outgoing (34%), followed by labour (10%), consumption of fixed capital (6%), repair and maintenance (4%), livestock (4%), and energy costs (3%). It is noteworthy that the value of unpaid labour is negligible in comparison to paid labour costs; this reflects the highly professional nature of commercial salmon farming with a fully contracted workforce.

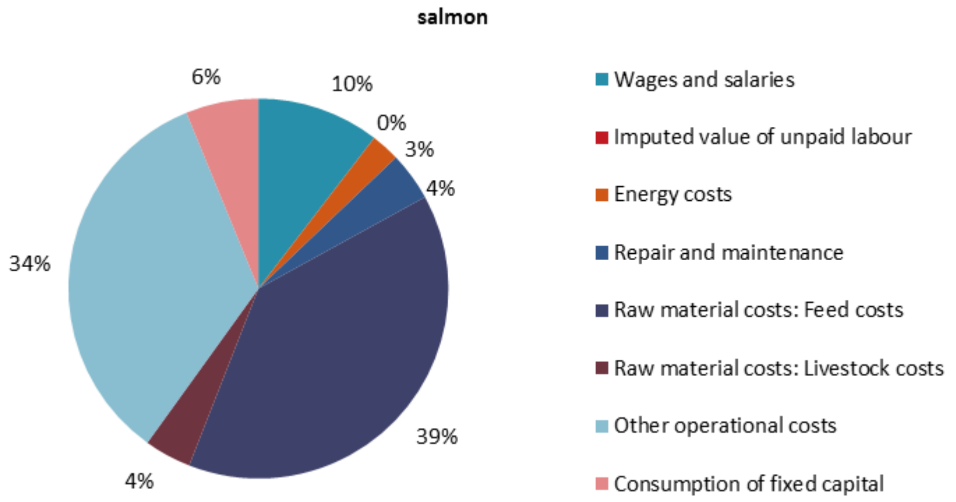


Figure 3.6: Costs breakdown for the EU salmon aquaculture: 2016.
Source: EU Member States DCF-EUMAP data submissions, 2018

The average price of Atlantic salmon has shown an increasing trend over the period 2008-2016, showing a minimum in 2009-2010 (€3.4/kg) and a maximum recently in 2016 (€5.8/kg). Please note that these prices are not corrected for inflation. Prices for EU salmon are likely to reflect the global market, influenced by the larger industries in Norway and Chile. In 2016, global salmon production fell, but due to strong market demand, global prices reached all-time high, increasing the profitability of salmon aquaculture[5].

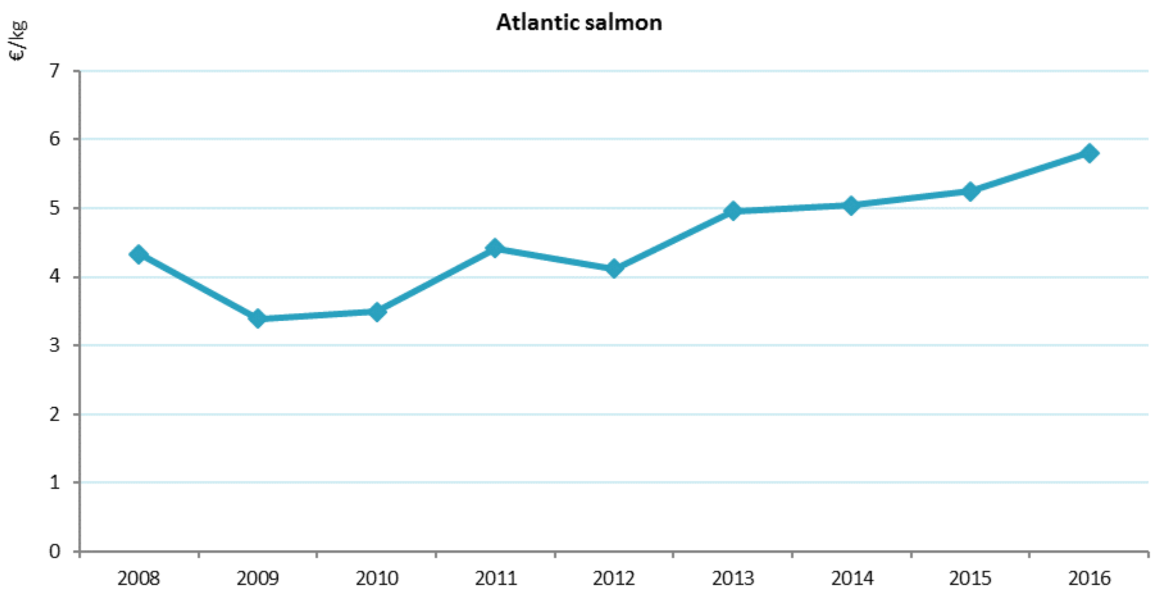


Figure 3.7: Price evolution of the main species of salmon group: 2008-2016.
Source: EU Member States DCF-EUMAP data submissions, 2018

5 http://www.hie.co.uk/regional-information/economic-reports-and-research/archive/value-of-aquaculture-2017.html

3.1.2 Seabass & Seabream

According to FAO aquaculture production data, the combined production of European seabass (*Dicentrarchus labrax*) and Gilthead seabream (*Sparus aurata*) increased during the 2008 – 2016 period from 245.3 thousand tonnes valued 1 480 million USD in 2008 to 377 thousand tonnes valued 2 067 million USD in 2016. Leading production countries are Turkey and Greece producing 37% and 24% of the total volume and 35% and 25% of the total value in 2016, respectively. The six largest producing countries: Turkey, Greece, Egypt, Spain, Tunisia and Italy produced more than 92% of the total volume in 2016. Turkey, Egypt and Tunisia have considerably increased the production volume since 2008, whereas the EU member states, Greece, Spain and Italy have also increased production volume during the same period by 6%, 10% and 12%, respectively. The volume share of the EU producer countries has decreased from 60% in 2008 to 44% in 2016. Accordingly, the value share of the EU producer countries has decreased from 65% in 2008 to 51% in 2016 (FAO, 2018).

Global production of European seabass (*Dicentrarchus labrax*) according to FAO production data, increased during the 2008 – 2016 period from 115 thousand tonnes valued 782 million USD in 2008 to 191 thousand tonnes valued 1 090 million USD in 2016. Turkey and Greece are the world seabass leading producers with 42% and 22% of the volume and 41% and 24% of the value produced in 2016, respectively. The EU member states produced 82 thousand tonnes, valued 557 million USD, in 2016. The main European producer is Greece with 42.5 thousand tonnes, followed by Spain and Italy with 23 thousand tonnes and 6.8 thousand tonnes, respectively. The volume share of the EU producer countries has decreased from 52% in 2008 to 43% in 2016. Accordingly, the value share of the EU producer countries has decreased from 61% in 2008 to 51% in 2016 (FAO, 2018).

Global production of Gilthead seabream (*Sparus aurata*) according to FAO production data, increased during the 2008 – 2016 period from 129 thousand tonnes valued 698 million USD in 2008 to 186 thousand tonnes valued 977 million USD in 2016. Greece and Turkey are the world Gilthead seabream leading producers with 31% and 26% of the volume and 28% and 27% of the value produced, respectively. The EU member states produced 83 thousand tonnes, valued 493 million USD, in 2016. The main European producer is Greece with 49.2 thousand tonnes, followed by Spain and Italy with 12.4 thousand tonnes and 7.6 thousand tonnes, respectively. The volume share of the EU producer countries has decreased from 68% in 2008 to 45% in 2016. Accordingly, the value share of the EU producer countries has decreased from 70% in 2008 to 50% in 2016 (FAO, 2018).

The European seabass and Gilthead seabream sector is undergoing a consolidation phase. The two major production companies in Greece were acquired (subject to the pending decision of the EU competition authorities) in 2018 by a capital investment fund which also controls the third largest production company in Greece and production companies in Spain. In Italy, the vast majority of the production is controlled by three companies. EU producers are also considering expansion to Tunisia. On the other hand, the major Turkish production company is further integrating vertically by the acquisition of fish meal production facilities.

The vast majority of seabass and seabream is produced and consumed in Southern European and other Mediterranean countries. The European industry, according to the DCF-EUMAP data consists of 154 enterprises (we miss information from Greece), which is an increase from the 2015. Most of these firms combine the production of the two species, and volumes of each may change yearly according to the demand and prices. When price of seabream decreases, producers usually increase the production of seabass and vice versa.

Table 3.5: Economic indicators for the EU seabass & seabream aquaculture: 2016.

Country	Number of enterprises	Total sales volume	Turnover	Employment	FTE	Average wage
	number	*tonnes*	*million €*	*number*	*number*	*thousand €*
Croatia	23	9	59.6	545	504	16.3
Greece		101.1	536.1	3,063	2,628	19.1
Italy	46	11.7	84.6	374	93	
Malta	1	2.3	10.6	147	147	8.6
Portugal	28	1.6	11.4	87	78	12.6
Slovenia	1	0.0	0.1	9	9	4.3
Spain	55	42.4	304.8	1,534	1,208	35.4
Total DCF reported	***154***	***168.3***	***1,007.2***	***5,759***	***4,667***	***22.6***
Other (non DCF)		10.2	64.9			
Total EU		**178.4**	**1,072.1**			

Source: EU Member States DCF-EUMAP data submission and FAO, 2018

Based on DCF data, in the reference period the seabass and seabream sector grew in terms of production and employment. EU production increased in 2016 to 168.3 thousand tonnes. At the national level, relatively biggest growth was recorded in Greece and Croatia (13%), while Italy recorded a decrease by 30%. In absolute values, Greece increased production from 90 thousand tonnes to 101 thousand tonnes, while Croatian production in 2016 reached 9 thousand tonnes, mostly intended for export. The value of EU production increased during 2016 at €1 007.2 million. Greece and Portugal recorded a significant increase of the turnover (27% and 23%) while Italian turnover decreased by 41%. Employment rose to 5 759 employees corresponding to 4 667 FTEs. On average the wages in the EU seabass and seabream aquaculture segment slightly decreased (we miss information from Italy).

Since 2012, the EU production of seabass and seabream has stabilised. The most important factors driving this stabilization refer to the 2008/2009 price decline and the weak demand in southern Europe as an effect of the lower income due to the recent debt crisis. Southern European member states have been influenced by the global economic crises (Italy, Slovenia, Croatia, Spain and Greece) during the recent years. Low credit availability in southern Europe also contributed to the stabilization of production. On top, rising feed costs have weakened the economic performance of the sector. Recent liquidity problems of the Greek producers did not allow the sector to fully recover from the 2008/2009 price decline up until 2016. In Greece, the concentration process of the sector during the past years was mainly financed by loans. A large number of Greek SME's and larger aquaculture enterprises were unable to repay these loans and a new restructuring and concentration cycle has started in Greece during 2014. The ownership of the major seabass and seabream aquaculture companies was transferred to the Greek banks during 2015/2016 thus later facilitating the flow of working capital. Ownership was then transferred during 2018 to an investment fund which now controls the three larger production companies in Greece. Further consolidation of the seabass and seabream sector in Greece is also likely, as other investment funds have also expressed their interest to consolidate production in Greece and consolidation is also underway in Italy. On the other hand, in the case of Croatia, there is a growth in production after the opening of the EU market for Croatia in 2013 (62% from 2013 to 2016) and overcoming the economic crises, following the investments and improvements in technology and distribution of fish products, which is expected to encourage the total production and may have an impact in further positioning of Croatia in EU aquaculture sector.

In addition, based on the national strategic plans for the development of aquaculture, as production growth is expected in forthcoming years, there is a need to reduce dependency on domestic market sales and increase the export market penetration of the species through collaboration and collective marketing strategies. Also, the need for improved data collection and dissemination is being recognized, so as the need for better environmental regulations and practices. Although profitability in the reference period has been the major issue, some steps should be taken towards laying a more stable foundation and encouraging the sustained growth of the industry in the future. In the next reporting period, it is expected to see results from product modernization and diversification, with more emphasis on preparation, portioning and packaging, also as in eco-labelling and organic certification.

Since 2008, non-EU countries such as Turkey, Egypt and Tunisia have considerably increased production of the two species. Until 2012, approximately 10% of the Turkish production was controlled by Greek enterprises, but since then, most of these assets were transferred to new owners. While Turkish seabream production is significant, most of the quantities produced are consumed in the local market. On the other hand, Turkish seabass production is exported to EU countries.

According to FAO market reports, for the last decade, Turkish production has been steadily increasing production volumes due to instabilities in the Greek industry, but also due to advantages in terms of production costs and received substantial investment and government support, which allowed pricing bellow Greek counterparts and entering into established and emerging markets alike. On the other hand, there exists a price premium for the European seabass production, which is attributed to the quality of the product. The delay of approximately one day for Turkish fresh seabass to reach the EU markets is reflected in the quality and the price of the product. The export subsidy that used compensate for the lower price of the Turkish product has also contributed to the lower price of the product in the EU market.

While export subsidies in non EU countries seem to have been eliminated, still the playing field is not levelled for the EU seabass and seabream producers. Non-EU production is not regulated to the same EU extend and producers do not need to maintain the same production standards (thus allowing for lower production costs). Nevertheless, both EU and non EU producers compete in the same markets.

Moreover, during past period, Turkey struggled with some bio-technical problems associated with lower quality of fish feeds and consequently with feed conversion rates and growth rates.

The Ukrainian conflict and the ban of the EU exports to Russia have restricted access to these markets for the EU aquaculture products, which caused increased export of Turkish fish products to Russia. However, due to price increase, there was a lower consumer demand for fish products in Russia during 2016.

While some Southern EU countries have started recovering from the recent debt crisis, demand for seabass and seabream is expected to grow further in the near future. A rise of the production, mainly for seabass and seabream, is expected by 2017 and onwards mainly as an effect of the higher prices (and thus profit margins) received by the producers during the second half of 2014 and 2015. The restructuring of debt and the bank loans, the changes of the shareholders and the changes of management for the main Greek production companies (during 2018 and 2019) are also expected to facilitate the expected rise of the production.

For the EU countries that reported seabass and seabream economic performance data by segment the turnover reached €1 007 million in 2016, mainly originating from the cages segment. Due to the transition to EUMAP segmentation where some of the countries reported their data in DCF segments and others adapted to EUMAP segments, there could be some inconsistencies in segments compared to previous time series. Also, as the overall dominance of cage farming techniques is present, economic results on sea bass and sea bream are being shown in total.

Performance indicators for the EU seabass and seabream producer countries are presented in the table below. It is obvious that for most of the EU countries, the seabass and seabream segment despite obtaining positive economic returns, got worse economic returns in 2016 compared to previous year, with exception of Greece and Italy, which maintained the positive trend. Italy was the only one with growing Future Expectations Indicator in 2016. Nevertheless, we expect for the Future Expectations Indicator to be closely related and time dependent to the implementation of the EMFF funding in each country.

Table 3.6: Economic Performance indicators for the EU sea bass and sea bream aquaculture: 2016.

Country	GVA	EBIT	ROI	Labour productivity	Capital productivity	Future Expectations Indicator
	million €	*million €*	*%*	*thousand €*	*%*	*%*
Croatia	13.7	2.4	1.5	27.1	8.2	3.5
Greece	189.8	132.5	14.2	72.2	20.4	-0.1
Italy	44.1	28.4	23.1		35.8	18.9
Malta	-0.5	-2.1	-37.7	-3.2	-8.4	-2.9
Portugal	2.8	0.8	15.5	35.8	53.0	46.8
Slovenia	0.3	0.2	8.3	28.2	11.8	-1.7
Spain	80.2	29.7	7.6	66.4	20.5	1.6
Total EU	330.3	192.0	11.8	62.6	20.3	2.2

Source: EU Member States DCF-EUMAP data submission, 2018

Despite the negative evolution of these indicators in 2016, in general economic performance of the industry has turned to positive results. The evolution of the markets during 2017 and 2018 will determine if the process of improving the economic results is consolidated or, on the contrary, the industry re-enters a negative context. The increase in supply, the behavior of prices, and the ability of the industry to diversify products and markets and consolidate improvements in the production process will be the main determining factors of this evolution.

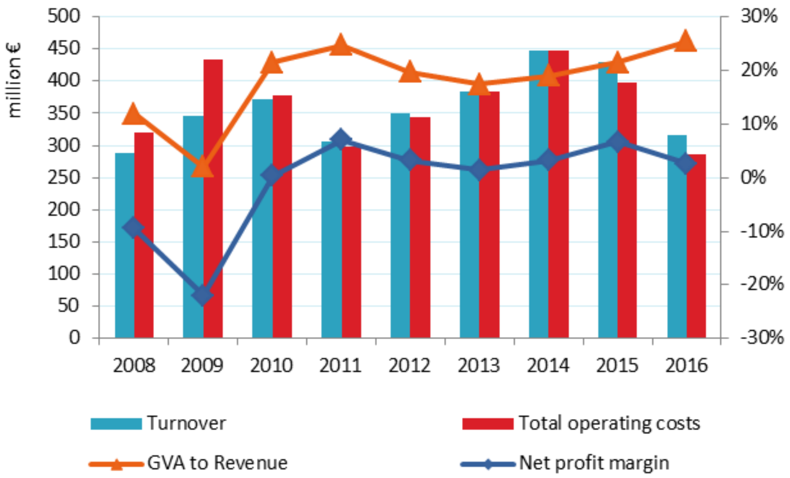


Figure 3.11: Economic performance indicators for sea bass and sea bream aquaculture: 2008-2016.

Source: EU Member States DCF-EUMAP data submission, 2016

As presented in the figure above, the EU seabass and seabream sector from 2012-2014, presents operating costs higher than the turnover thus growing losses are recorded for 2013 and 2014. However, due to market stabilization, turnover in 2015 has for the first time since 2010 exceeded the total operating costs.

In the figure below, the cost structure of the EU seabass & seabream aquaculture subsector is presented for 2016. In total, raw material (feed costs and livestock) account for 60% of the total cost, slightly increasing from 2008. From 2015 to 2016, feed costs share rose from 38% to 46%, following decrease of share of livestock costs from 21 to 14%. Other operational costs and wages account for 19% and 13% of the total cost respectively in 2016. Other operational costs vary between 15% and 20% since 2008 while wages and salaries present a decreasing trend. Part of the decreasing trend may be attributed to the decreasing wages and salaries in the southern EU countries but also to the outsourcing of some activities in the segment. After increase from 1% in 2008 to 7% in 2014 reflecting the increasing fuel prices for the period 2008 to 2014, the energy cost share decreased to 2% in 2016. According to market reports, in the next reporting period, it is expected to realize improvements in production, processing, logistics and marketing that will help to boost company margins through demand generation and cost savings.

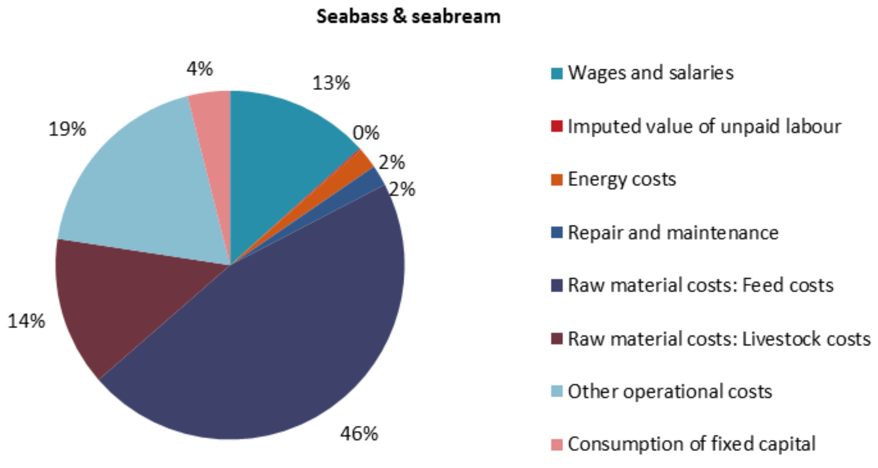


Figure 3.13: Costs breakdown for the EU sea bass and sea bream aquaculture: 2016.

Source: EU Member States DCF-EUMAP data submission, 2018

In the next figure, the price evolution of European seabass and seabream is presented. Low seabream price for 2008-2009 is identified as well as an upward trend since 2010 with a decline in 2013 and a new upward trend since 2015. On the other hand, seabass price is rather stable till 2011, presents an upward trend up to 2013 and, for both species, the price seems to converge in 2015 and further in 2016 at approximately €5.6/kg. The price of meagre presents a constant upward trend since 2010 and converges to the price of seabream and seabass in 2016. The predictions for 2017 are uncertain due to a higher harvest volume expected during 2017 and 2018 in the largest producing countries – Turkey, Greece and Spain. In order to maintain stable market prices, it is necessary to level the playing field for EU and non EU producers, diversify the export markets and develop a wider range of products.

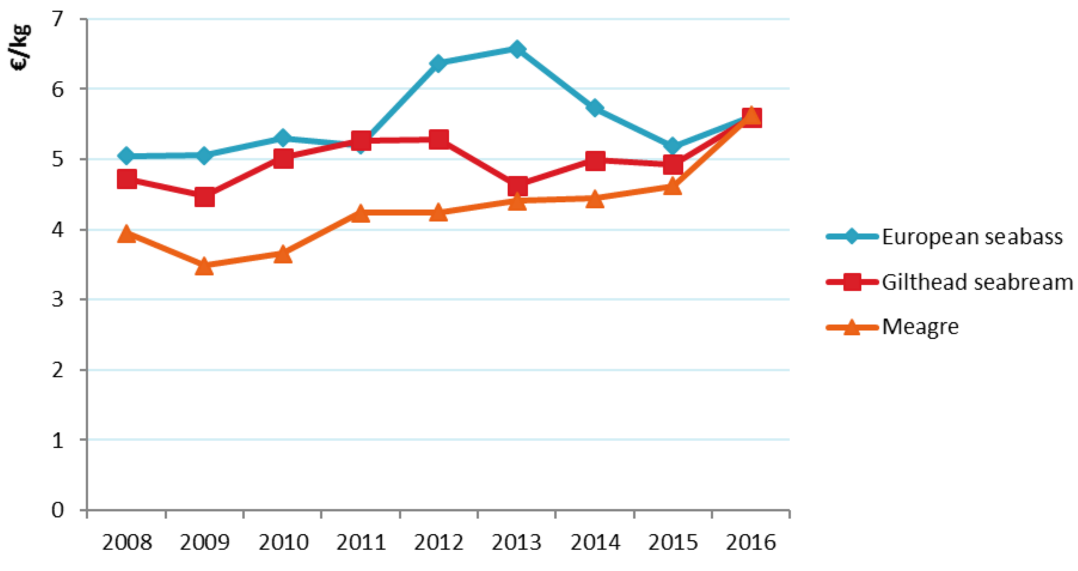


Figure 3.14: Price evolution of the main species of sea bass and sea bream group: 2008-2016.

Source: EU Member States DCF-EUMAP data submission, 2018

3.1.3 *Atlantic Bluefin Tuna*

Three Member States are farming Atlantic Bluefin tuna in the EU, Malta, Spain and Croatia, which are all operating in the Mediterranean Sea. They are all using the same technique for the production of tuna, which is tuna fattening in sea cages. The overall sales volume amounted to 18.8 thousand tonnes in 2016. Figure 1 shows that 60% of the total production derives from Malta, followed by Spain (24%) and Croatia (16%).

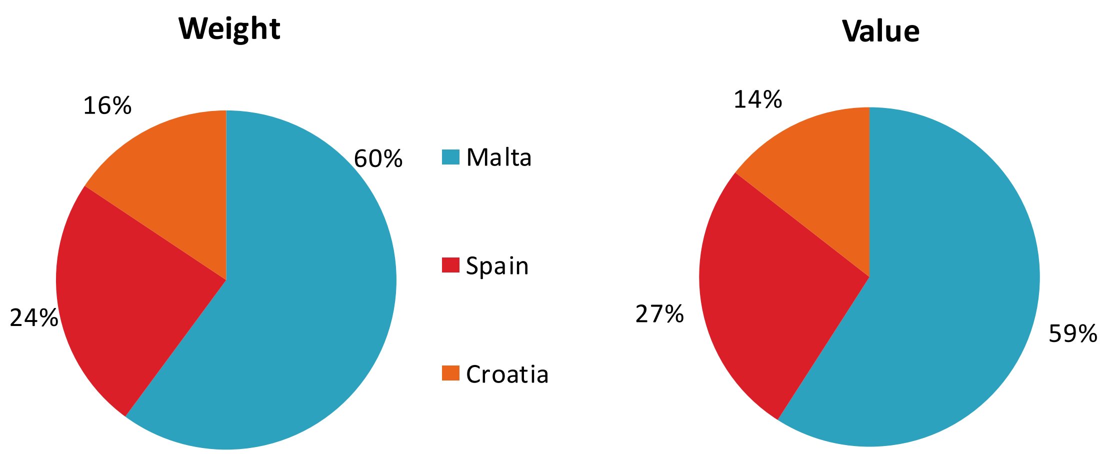


Figure 3.15: Total EU Sales Volume and Turnover for Atlantic Bluefin Tuna aquaculture production by MS: 2016

Source: EU Member States DCF-EUMAP data submission, 2018

The overall value that was generated from this activity in 2016 was €258 million in sales value. Malta generated the largest turnover covering 59% of the total EU turnover for this specie, followed by Spain (27%) and Croatia (14%).

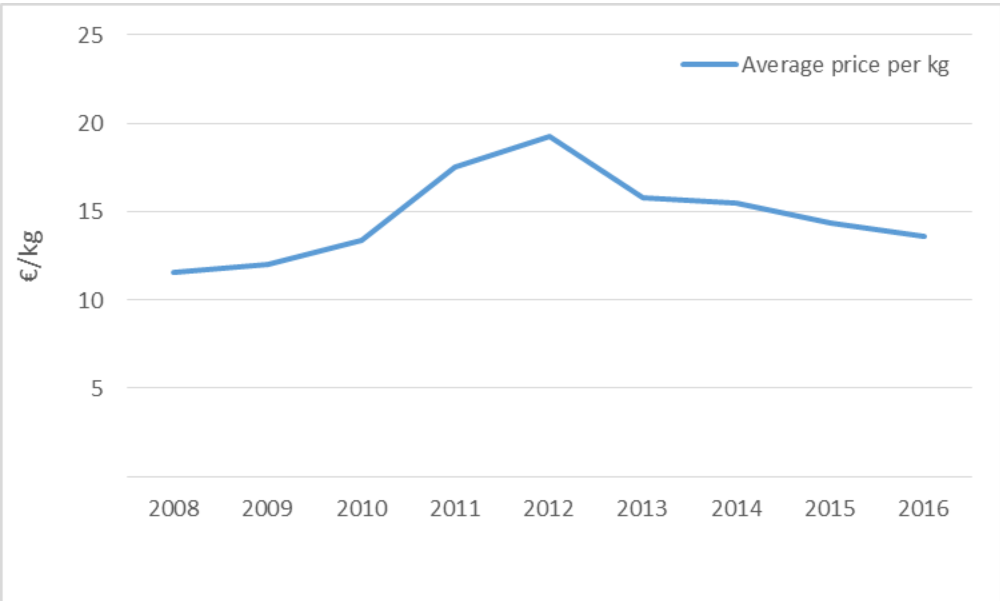


Figure 3.16: Average price per kg of farmed Atlantic Bluefin Tuna: 2016

Source: EU Member States DCF-EUMAP data submission, 2018

The average price per kg of farmed Atlantic Bluefin tuna, based on DCF data amounted to €13.58 per kg. The price increased from 2008 to 2012 reaching a price of €19.22 in 2012. However, the price has shown a declining trend of farmed tuna since 2012. From 2015 to 2016, the average price decreased by 5% and from 2012 to 2016 the average price per kg of Atlantic Bluefin Tuna dropped by 29%.

3.1.4 *Other marine fish species*

Figure 3.17 shows the remaining marine species produced in the EU. The total value and volume was €131 million and corresponding to 20 thousand tonnes in 2016. Turbot was the most important species in terms of value and volume, contributing with €72 million and ten thousand tonnes. Turbot was mainly produced in Spain and Portugal. The second most valuable species was meagre, contributing 17% to the total value and 21% to the total volume. The main producers for meagre were Greece, Spain, Croatia and Portugal. Red porgy had an important share in other marine species production. Red porgy was farmed in Greece. Other marine species cultured in lower amounts were Red porgy and Senegalese sole.

For most of the species the average price has been rather stable with short-time fluctuations through the period 2008-2016. Compared to previous year the average price increased for Senegalese sole, turbot and meagre. However, the average price for red porgy and flathead grey mullet decreased. The highest average price was for Senegalese sole at €11 per kg.

Figure 3.6: Main species, produced in the other marine fish farming facilities: 2016.

Source: Eurostat, 2018

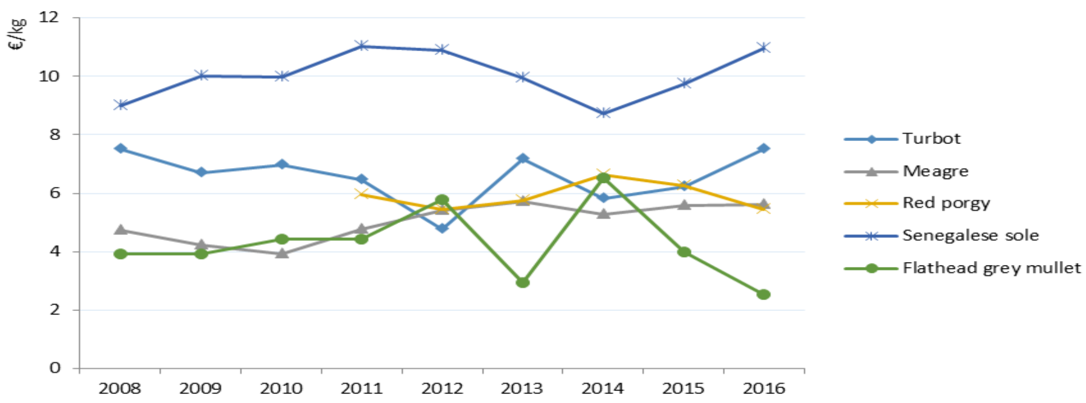


Figure 3.18: Price evolution of the main species in other marine fish segment: 2008-2016.

Source: Eurostat, 2018

3.2 Shellfish aquaculture

Worldwide seafood demand for bivalves continue to grow. The human health benefits from bivalve consumption, and their eco-friendly image among species coming from aquaculture, have attracted new consumers to this species group. The high demand for bivalves have resulted in a 5-10% price increase in international and domestic trade. Furthermore, demand growth is likely to continue in the coming years (FAO, 2018).

Sixteen Member States are involved in the EU shellfish sector. The shellfish aquaculture is to a large extend based on small scale family owned enterprises. This sector contributes actively to external trade and has a very important social dimension given the high number of persons employed and the supply of animal protein for human consumption.

The shellfish sector does not face limiting environmental concerns in terms of nitrogen and phosphorus emission, because shellfish help to improve water quality by filtering the water for phytoplankton absorbing these nutrients. However, shellfish farmers dread other problems in terms of limitation of suitable production sites, competition for space (conflicts of interest) and spreading of diseases such as the one faced by France for oysters or the red tides in Spain. This sector shows high variability in production over time depending on environment conditions, seeds, prices, livestock purchases, species, and technics used. In the European Union, the shellfish sector is very different from one Member States to the other.

The total sales volume for the EU28 aquaculture shellfish sector is estimated to be 0.66 million tonnes and the total value of sales (turnover) is estimated to be €1.1 billion in 2016 (Table 3.7).

Table 3.5: Economic indicators for the EU aquaculture shellfish subsector: 2016.

Country	Number of enterprises	Total sales volume	Turnover	Employment	FTE	Average wage
	number	*thousand tonnes*	*million €*	*number*	*number*	*thousand €*
Bulgaria	33	1.6	1.2	94	86	2.9
Croatia	117	0.7	1.4	169	100	12.2
Denmark	5	1.7	1.3	10	7	66.0
France	2,432	191.8	656.5	13,841	7,892	26.0
Germany	10	22.2	25.3	127	103	40.6
Greece	201	25.7	10.3	585	575	5.5
Ireland	255	26.4	57.0	1,719	829	25.7
Italy	400	95.6	137.8	3,656	1,688	24.7
Netherlands	70	56.5	60.3		206	67.0
Portugal	1,362	5.7	42.5	2,362	557	12.2
Slovenia	6	0.6	0.7	11	11	17.2
Spain	2,717	219.8	82.5	14,465	3,851	13.9
Sweden	27	2.3	1.6	106	21	26.1
United Kingdom	205	16.9	28.3	670	490	15.9
Total reported	***7,840***	***667.5***	***1,106.6***	***37,815***	***16,415***	***21.9***
Other non DCF		0.1	0.3			
Total EU		**667.6**	**1,106.9**			

Source: EU Member States DCF-EUMAP data submission and FAO, 2018

Reported data show the existence of more than 7.8 thousand enterprises in the EU aquaculture shellfish sector in 2016, a very slight decrease compared to 2015. The sector is very atomised. With an and average size of 4.8 employees and 2.0 FTEs, the majority of enterprises (80%) are micro-enterprises (with less than 5 employees).

In 2016, the EU28 aquaculture shellfish sector employed more than 37.8 thousand persons. The shellfish sector has an important share of part-time work, since the ratio between the employment measured in full time equivalents (FTE) and the total employment was 43%. The most important costs items of the EU shellfish aquaculture sector were labour and livestock.

Available data suggest that the average wage per FTE was €21 900 in 2016, increasing by 1% since 2015. There is a large variability of wages across EU Member States (e.g. from €2 900 in Bulgaria to €67 000 in The Netherlands), explained in part by the contributions of unpaid labour and the use of different techniques, for example, more capital intensive techniques in Germany and in The Netherlands. The unpaid labour could be very important in the shellfish aquaculture and imputed value of labour reached more than half of the total wages in France and Spain. A large part of the employment is not recorded under a formal contract given the fact that many workers are either the firm owners or their family members.

Table 3.6: Economic Performance indicators for the EU aquaculture shellfish subsector: 2016.

Country	GVA	EBIT	ROI	Labour productivity	Capital productivity	Future Expectations Indicator
	million €	*million €*	*%*	*thousand €*	*%*	*%*
Bulgaria	1.1	0.0	-0.3	12.9	17.7	-13.9
Croatia	1.8	1.0	14.5	17.7	26.9	-1.8
Denmark	0.8	0.2	9.3	113.1	31.6	4.9
France	388.7	118.4	12.4	49.3	40.8	-1.4
Germany	14.4	8.7	19.4	139.7	32.0	25.0
Greece	10.1	6.9	741.5	17.5	1080.9	-1.2
Ireland	39.4	16.6	16.2	47.5	38.5	-0.4
Italy	90.5	44.4	34.5	53.6	70.3	29.5
Netherlands	35.4	18.9	14.0	172.4	26.2	3.5
Portugal	39.9	26.0	77.8	71.6	119.6	-0.5
Slovenia	0.6	-0.3	-5.3	54.5	10.6	-12.6
Spain	59.8	3.5	4.8	15.5	83.1	-5.0
Sweden	1.8	0.9	35.5	87.0	70.5	-12.7
United Kingdom	16.1	4.7	17.4	32.9	60.2	0.7
Total EU	700.3	249.8	14.7	41.8	43.6	-0.2

Source: EU Member States DCF-EUMAP data submission, 2018

With €250 million of EBIT, the EU shellfish sector obtained profits in 2016. Gross Value Added generated in 2016 was €700 million, a 9.4% decrease from 2015. Most Member States producing shellfish reported a positive profitability, with only Slovenia recording losses. French figures show an important increase in EBIT since 2015, where the oyster production generating a negative EBIT. The profitability measured in ROI terms was 14.7% in 2016. Since 2013, with the red ties in Galicia and a very low production the economic situation has improved for Spain and the level of production have been increasing during the last year. However, in 2016 Spanish shellfish production (mostly Mediterranean Mussel) decreased 4% compared to 2015. Since 2013, Spain has diversified its production with oysters to avoid such decreasing in the earnings.

Labour productivity for the EU aquaculture shellfish sector was €37 815 per FTE and capital productivity was 43.6%, in 2016. Nevertheless, this figure hides a huge discrepancy between Member States from 10.6% in Slovenia to 119% in Portugal.

The main species produced in EU shellfish farming facilities were Mediterranean mussels, blue mussels, Pacific cupped oyster and Japanese carpet shell. In value terms, the most important species are Pacific cupped oyster (38% of the total value), blue mussels (22%), unidentified mussels (13%), Japanese carpet shell (11%) and Mediterranean mussels (8%).

Figure 3.7: Main species, produced in the EU shellfish farming facilities: 2016.
Notes: See mussels nei are mainly blue mussel and Mediterranean mussel.
Source: FAO, 2018

3.2.1 Mussel

World´s total mussel production reached 2 million tonnes and 3.8 billion USD in 2016 (FAO, 2018). According to the data reported to FAO, the EU represents approximately 90% of world production of blue and Mediterranean mussel, both in volume and value. However, it is known that some countries do not report production per species, instead opting to refer to the country of production (e.g. Chilean mussel).

The main species of mussels farmed in the EU are blue mussel (*Mytilus edulis) and Mediterranean mussel (Mytilus galloprovincialis). Other species of mussels relevant in the international markets and farmed outside the EU are: Chilean mussel (Mytilus chilensis) or (Mytilus edulis platiensis); the New Zealand* green-lipped mussel, (*Perna canaliculus*); and the Korean mussel (*Mytilus Coruscus)* and (*Crenomytilus grayanus)*.

In Table 3.9 economic indicators for the mussel sector in the EU is shown. According to data collected under DCF, the volume of mussels produced in the EU is 481 thousand tonnes, valued at €365 million. In comparison to 2015, this represents a 2% decrease in volume and a 3.5% decrease in value. This is due to the fall in production and turnover in Spain, the main producer of mussels. Blue mussel prices are lower in 2016 compared to 2013, while Mediterranean mussel prices remain stable. Two main species produced in EU are Mediterranean mussel (243 thousand tonnes) and blue mussel (112 thousand tonnes).

90% of the companies surveyed in the DCF/EUMAP area are concentrated in five countries, such as: Spain (61%), France (12%), Italy (7%), Greece (6%) and Croatia (3%). More of 76% of volume sales is concentrated by the same countries, which have a turnover which represents 70% of the total segment (2016). Spain offers 45% of volume sales, while France is the most performing MS with respect to turnover: although it expresses 11% of volume of sales, it accounts for 39% of turnover. Analysing the employment data, the five MS represent more than 91% of the employed, equivalent to about 86% FTE of the mussel segment in the EU. The highest average salary of all MS is paid to Danish employees (around €66 thousand per year) and to the Dutch employed (around €65 thousand per year). On the other hand, among the top five MS producers, the French employed earn an average higher salary (more than €26 thousand per year). The lowest average wage is paid to those employed in Greece (less than €5.5 thousand per year). Italy has an average wage about 23% lower than the average EU salary (€18.6 thousand); Spain also has an average wage lower than about 25% compared to the average EU one, while France average annual wage is about 43% higher than average estimated wage in EU. The average wages differ significantly among the countries, which could be interpreted as an indicator for the technological and organisational development in the different countries.

Table 3.7: Economic indicators for the EU mussel aquaculture: 2016.

Country	Number of enterprises (number)	Total sales volume (thousand tonnes)	Turnover (million €)	Employment (number)	FTE (number)	Average wage (thousand €)
Bulgaria	33	1.6	1.2	94	86	2.9
Croatia	112	0.7	1.3	157	92	12.3
Denmark	5	1.7	1.3	10	7	66.0
France	385	55.2	141.9	2,215	1,426	26.4
Germany	10	22.2	25.3	127	103	40.6
Greece	201	25.7	10.3	585	575	5.5
Ireland	87	16.2	12.3	369	207	30.7
Italy	224	70.0	45.4	1,023	947	14.3
Netherlands	51	53.2	44.8		158	64.7
Portugal	17	0.9	1.8	109	90	9.8
Slovenia	6	0.6	0.7	11	11	17.2
Spain	1,969	215.4	56.7	7,859	2,641	13.9
Sweden	8	2.3	1.5	40	17	30.0
United Kingdom	103	14.7	20.8	323	247	31.6
Total reported	***3,211***	***480.5***	***365.3***	***12,922***	***6,606***	***18.6***
Other non DCF		0.0	0.0			
Total EU		480.5	365.3			

Source: EU Member States DCF-EUMAP data submission and FAO, 2018

Social importance of mussel sector

The mussel is cultivated mostly in Galicia, where it is a traditional and consolidated sector. The industry has a significant impact on the Galician economy. Most of the people working in the sector is from the local area. It is a sector with a high volume of production. The workers are often self-employed people and there are a lot of part time workers; many of them belonging to the same family as the owner. Other workers are fishermen who work on the rafts during the season where the fisheries are closed.

It is important to highlight that the sector is closely related to the canning industry, also situated in the same areas, and in which most of the inputs are from the Galician. Furthermore, there are no external investments in the Spanish mussel sector.

In Italy mussel farming has become an important work activity in terms of employees. In some Adriatic regions, companies, most producer cooperatives, are starting investments to buy boats equipped with mussel purification plants. The boats are> 18 meters long and have the double function of being at the service of the installations and also of bagging the product intended for commercialization. In the last three years, important innovations are taking place in the sector, especially as regards the vertical integration of the production chain. Further interest has been that of being able to sell pre-growth product to other installations both in Italy and abroad.

Main techniques

Three main farming techniques are being used in the production of mussels in the EU. Rafts, long line and bottom harvest are well differentiated methods of production, which set further differences in terms of costs and market prices.

The bulk of the whole EU mussels' production is harvested in the Spanish North West region of Galicia where rafts are the dominant technique. A raft is a floating platform with pending ropes of around 30 meters in the form of a matrix, which can be folded according to the depth where the platform is located. The mussels are attached to the rope and covered with a net produced with organic materials that will be progressively disappearing until the mussel fixes to the rope in a natural way. Every row in the matrix corresponds to a particular harvest, which will be collected and replaced in the appropriate date maintaining a continued production along the whole year. Rafts require a minimum depth of around 8 to 10 meters in order to result in efficient outputs.

Long line cultivation shares with rafts the use of ropes where vertical ropes or mussel bags are hang, but instead of the vertical disposition used in rafts, the ropes are horizontally displayed. This fact results in larger needs of space which not are always available due to competing water usages. However, it allows mussel culture in shallow waters where rafts would not be suitable.

Finally, bottom cultivation uses beds or poles fixed in the bottom where the mussels are deposited or attached. It solves some of the problems with required space in long line, but it is still not as efficient as rafts.

The seed mussels are collected from special areas and are then carried to areas where the growth conditions are better for the mussels. These areas are assigned by state authorities for a certain fee and timely limited. The mussels are then, after 1-2 years collected from the cultural spots and mostly sold at the mussel auction at Yerseke in the Netherlands. The most important markets for mussels from Germany are the Benelux-countries, France and in Germany especially the Rhineland. The collection of the mussels is done by dredges or beam trawl. The volume of seed mussels varies from year to year. In some years in the last decade almost no seed fall could be noticed. With a time lag of one to two years the volume of mussels for consumption varies accordingly. This is the main reason for the fluctuation of income in this sector. The employment is relatively stable.

All the three techniques require the use of boats in order to collect the mussels and maintain the facilities. Whenever any member country did not report the technique used for mussel culture, the data were allocated into the generic “mussel other” category. The figures for this category should be considered cautiously since different techniques, including rafts, long line and bottom, could be mixed together.

The evolution of the operational costs sets shows different developments in the mussel segments. While mussel rafts show quite stable figures in GVA to revenue compared since 2009, with decrease income and operating costs, the segment mussel bottom shown increase in net profit margin and in operating costs and total income compared to 2015. Mussel long line shows a decreasing net profit margin and GVA to revenue, caused by a significant increase in operating costs. Mussel other have a highly decrease in these 4 indicators compared to 2015. Total operating costs fall more sharply than total income. More information on the development of the time series in Figure 3.8 can be found in the last EU aquaculture report.

As it may be expected, the important technical differences across the three techniques results in significantly different cost structures in terms of what are the relevant items and their magnitudes.

Figure 3.8: Development of economic performance for the EU mussel aquaculture: 2008-2016.

Source: EU Member States DCF-EUMAP data submission, 2018

One of the cost categories setting differences across techniques is the imputed value of unpaid labor. This has to do with the legal form of the enterprise. Raft and bottom culture records a large number of personal and family owned business in which other members of the family random or periodically contribute to the activity without a formal contract or salary. In contrast, the long line segment is mainly composed by cooperatives and consortia and such kind of informal labor is rarely present. Unpaid labor represents 51% of the total raft costs and 12% in bottom culture, but only 5% in long line. This is also reflected in the importance of the formal wages and salaries which are 28% in long line, 22% in bottom and 18% in rafts.

In Germany and the Netherlands each mussel enterprise has at least one vessel of about 45 m length with prices of about €4.5 million, meaning that the capital invested is quite high.

Finally, energy costs are quite similar except for the long line segment, where 14% of the costs are energy costs.

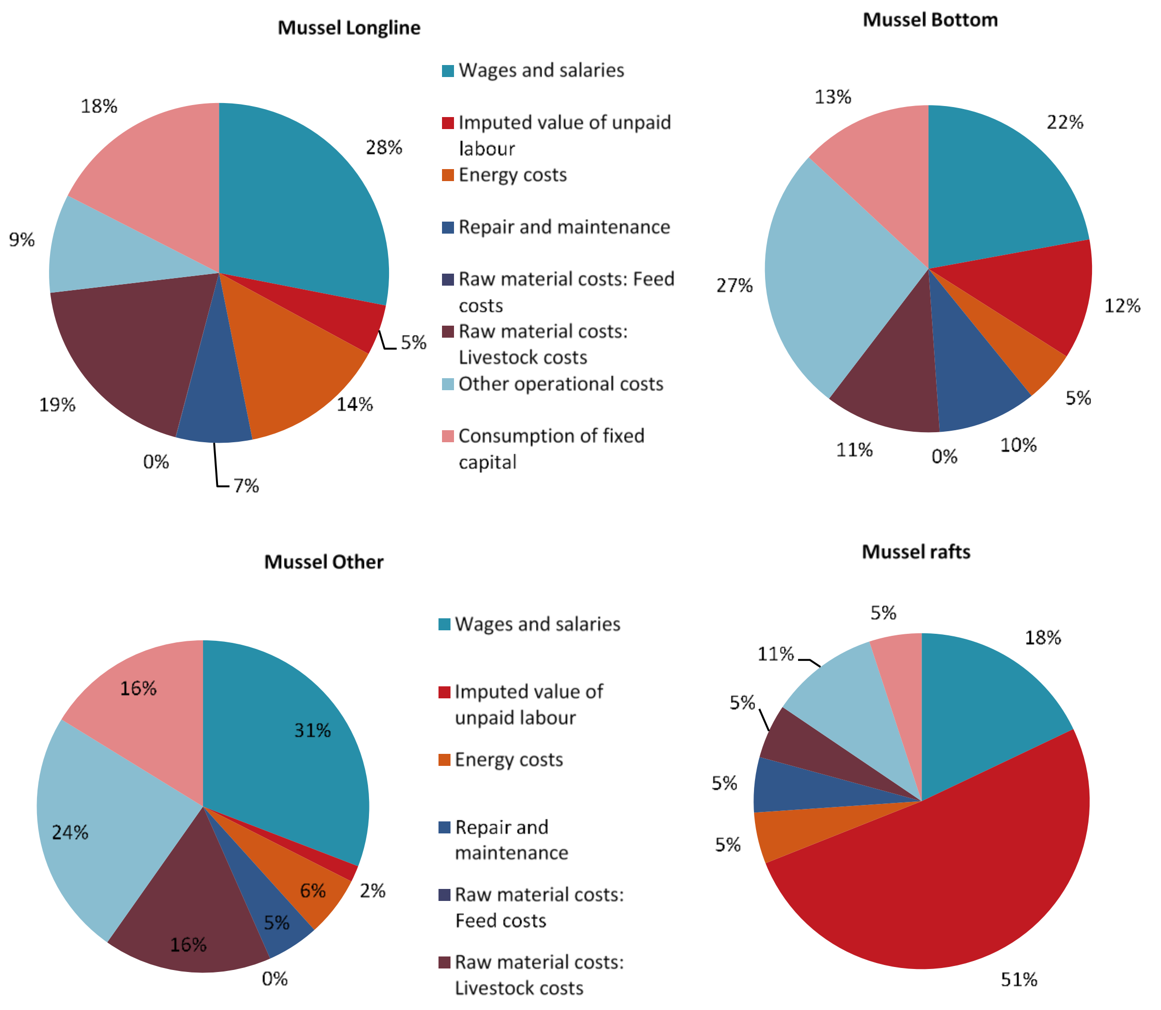


Figure 3.9: Costs breakdown for the EU mussel aquaculture: 2016.

Source: EU Member States DCF-EUMAP data submission, 2018

Mussel production in Germany and Netherlands is based on relatively large, professionalised companies. The amount of unpaid labour in these companies is low or absent. In other countries the business is very much depending on smaller family owned companies with family members helping.

For most mussel farmers, the total costs of production are almost fixed, given the absence of feed and livestock costs. With production, and thereby turnover, varying significantly per year, labour productivity shows high variation as well from year to year for a specific country. This however is not explained by changes in the workforce, instead reflecting natural variation in production only. The differences in labour productivity across countries show the different capital intensity in the reported countries. In Denmark, Germany and the Netherland production is based on a high input of physical capital, while in other countries the production is more labour intensive.

The EU mussel aquaculture gross value added reached more than €232 million. EBIT reached almost €75 million, showing a positive economic performance compared to 2015, while the ROI was at 14.3%. Labour productivity reached around €38 thousand per year, stable compared to 2015. A capital productivity of 38.7% in 2016 is a decrease compared to the 42% achieved in 2015.

Table 3.8: Economic Performance indicators for the EU mussel aquaculture: 2016.

Country	GVA	EBIT	ROI	Labour productivity	Capital productivity	Future Expectations Indicator
	million €	*million €*	*%*	*thousand €*	*%*	*%*
Bulgaria	1.1	0.0	-0.3	12.9	17.7	-13.9
Croatia	1.6	0.9	16.8	17.9	29.6	-1.3
Denmark	0.8	0.2	9.3	113.1	31.6	4.9
France	103.7	52.2	23.4	72.7	46.5	-1.7
Germany	14.4	8.7	19.4	139.7	32.0	25.0
Greece	10.1	6.9	741.5	17.5	1080.9	-1.2
Ireland	6.1	0.2	0.5	29.4	15.6	-0.9
Italy	18.1	2.1	3.1	19.2	27.1	30.3
Netherlands	21.7	8.9	6.7	137.1	16.2	2.6
Portugal	0.5	-7.4	-23.1	5.4	1.5	-1.4
Slovenia	0.6	-0.3	-5.3	54.5	10.6	-12.6
Spain	43.0	4.5	12.4	16.3	118.2	-5.5
Sweden	1.8	1.0	39.4	109.4	74.5	-14.0
United Kingdom	8.6	-2.9	-10.7	34.8	32.1	0.7
Total EU	232.1	75.0	14.3	38.1	38.7	1.4

Source: EU Member States DCF-EUMAP data submission, 2018

Figure 3.10 show the performance of the mussels sector. Since the financial crises in 2008 the income, GVA and net profit margin has improved in the sector. However, the turnover and total operational cost has declined until 2012, indicating a lower activity in the sector. In 2016, GVA to revenue and net profit margins decrease compared to 2015.

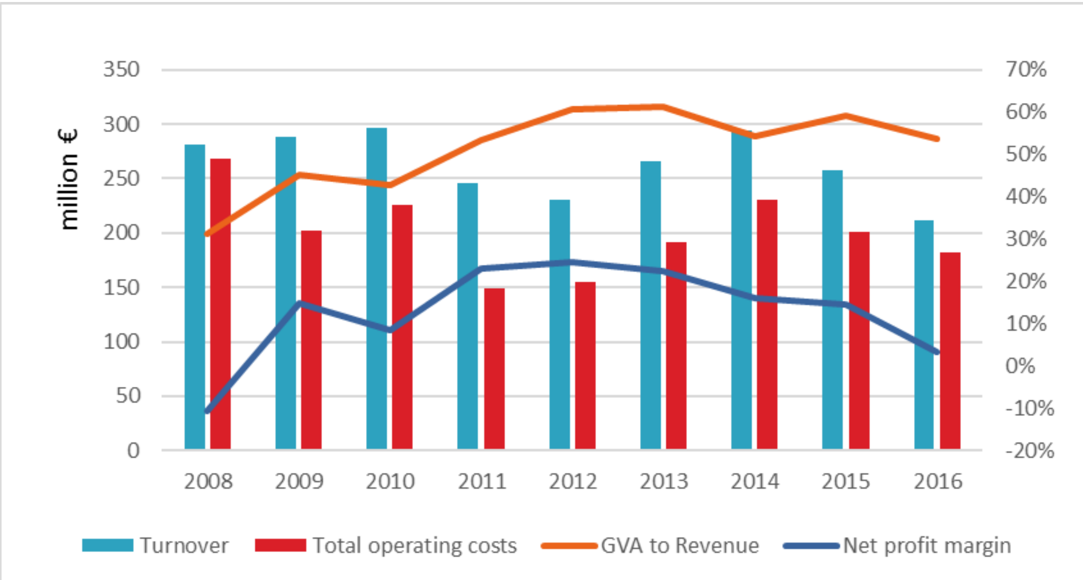


Figure 3.10: Economic performance indicators for mussel aquaculture: 2008-2016.

Source: EU Member States DCF-EUMAP data submission, 2018

The market price for a kilo of blue mussels was more than €1 more expensive than for Mediterranean mussels in 2012, while in 2016 this difference became smaller, tending to about €0.35 per kg. Mediterranean mussels had an average price around 60 cents per kg along the period observed, and had a stable evolution. The peak in 2009 in Figure 3.21 is more due to absence of data for the year rather than a real significant increase in market price. The price for blue mussel increased 60% per kilo from 2009 until reaching almost €1.8 per kg during the 2013. In 2016, prices for blue mussel have fallen down to almost € 1.1 per kg.

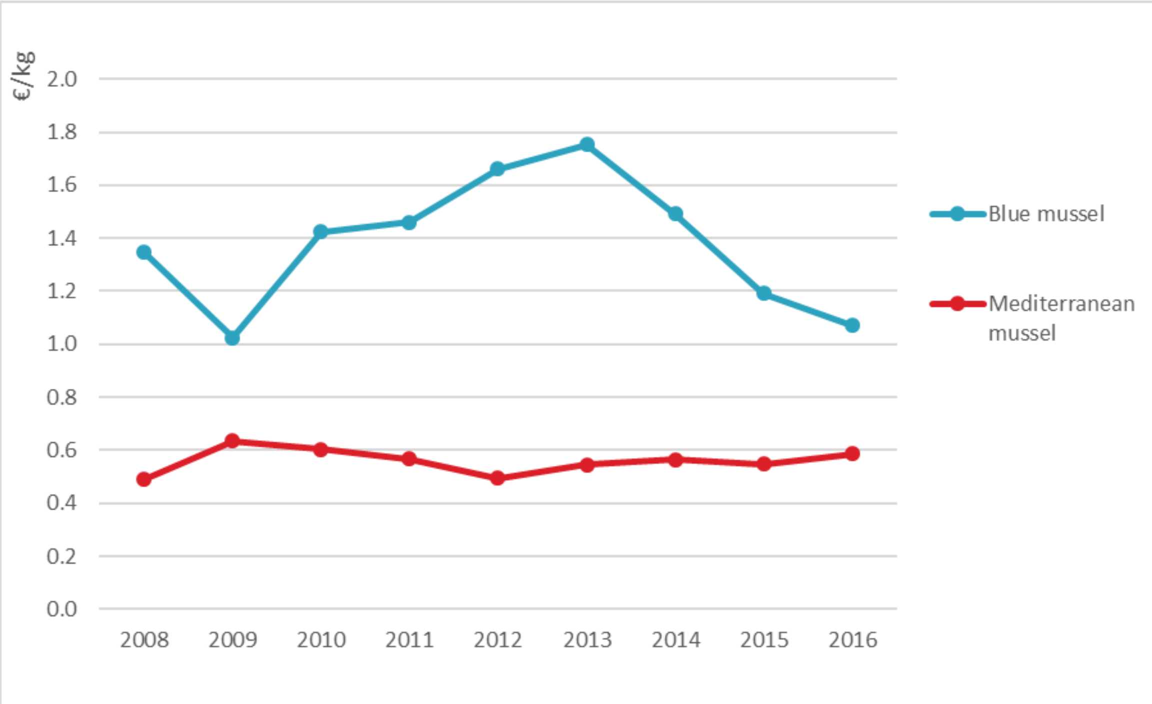


Figure 3.11: Price evolution of the main species of mussel group: 2008-2016.

Source: EU Member States DCF-EUMAP data submission, 2018

Table 3.11 shows the Future Expectations Indicator (FEI) which is simply the ratio of net investment and depreciation, meaning that positive values show more investments than depreciation of capital and vice versa. It is assumed that positive values reflect positive expectation about the future development in the sector, while negative values over consecutive years reflect insecurity or bad expectations and will lead to a decrease of the sector if it pertains for a longer period. One has to keep in mind that a lot of costs are fixed, meaning that bigger investments like buying a new vessel occurs once in two or three decades. This is not reflected in this short time series presented in the table. For example, 2009 figure for Ireland and 2012 figures for UK show a big investment while in the following years depreciation increased due to the big investments but no relevant new investment in the following years has been made, resulting in much smaller numbers for the FEI. Overall since 2008 the mussel sector shows positive FEI numbers, meaning that obviously the business is still attracting financial resources.

Table 3.9: Future Expectation Indicator for the mussel sector

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016
Bulgaria					24.7	16.0	-15.8	-20.4	-13.9
Croatia					-3.9	-5.0	12.3	42.0	-1.3
Denmark	28.5	14.0	-3.7	-1.0	-28.3	-7.0	33,0	1.3	4.9
France			6.2	0.0	-13.3	-9.0	-11,0	-11.2	-1.7
Germany	-7.2	-2.0	-9.1	-5.0	-10.4	-7.0	-2.9	-4.2	25.0
Greece							-1.6	-0.4	-1.2
Ireland	1.0	29.0	-14.8	-6.0	-5.6	-6.0	1.3	-3.7	-0.9
Italy	9.1	12.0	25.5	20.0	38.5	35.0	28.4	37.3	30.3
Netherlands	11.3	5.0	4.6	-4.0	-2.8	49.0	59.3	3.9	2.6
Portugal					-11.4	-12.9	-12.9	25.1	-1.4
Slovenia	3.5	-2.0	10.5	23.0	14.1	40.0	5.1	4.6	-12.6
Spain	7.3	1.0	2.3	-2.0	-1.1	1.0	0,0	-4.8	-5.5
Sweden									
United Kingdom					39.6	13.0	3.9	9.0	0.7
Total EU	7.4	11.0	6.0	1.0	0.2	4.0	2,0	4.8	1.4

Source: EU Member States DCF-EUMAP data submission, 2018

Outlook

Mussel production can be considered as an environmental friendly business, as no feed is necessary and the mussels take nutrients from the water column. This also includes stable production costs for the producers as the variation of seed and energy costs does not affect the business so much as in finfish aquaculture and recirculation systems. On the other hand, it is an environmental depending production, which in some cases hinders a stable supply of seafood products from year to year. In some areas like France the problem of red tides is very relevant, in the Netherlands and Germany the problem of lacking seed mussels is an obstacle for stable and growing production. Bottom culture depend on the supply of mussel seed, either from the market or by own collection. There is natural variation in the amount of mussel seed available. Concerns about the ecological impact of mussel seed collection in the Wadden Sea have led to harvest restrictions. The environmental aspect has had important impacts on mussel farming. Some producer organizations in Italy have obtained the recognition of "protected designation of origin product" PDO, but environmental conditions have damaged production expectations. In the case of mussels, it is important to enhance the offer with attributes such as certifications and organic.

The analysis of mussels still lacks from the data quality. Segmentation by species and technique cannot clearly be differentiated due to different understanding by MS when submitting data and due to different dominant technique in different countries. Some MS did not report data for all of the years covered by DCF data collection scheme (e.g. UK and Greece) and some joined EU later than 2008. This means, that all analysis of the European mussel sector must be taken with caution. The mussel business differs between MS by technique and capital intensity. In all cases it contributes to rural development, either by direct employment, linkages to other industries or by providing positive external effects on tourism and regional gastronomy. More than this, mussels as an environmental friendly business contributes to food supply by providing valuable animal proteins and other nutrients, and the production itself improves the environmental conditions by taking nutrients from the water column.

3.2.2 Oyster

There are different species of oysters produced in aquaculture: Pacific cupped oyster, American cupped oyster, Slipper cupped oyster, Sydney cupped oyster, Indian backwater oyster, European flat oyster, Mangrove cupped oyster, Cortez oyster, Chilean flat oyster, etc. Total oyster production reached 5.59 million tonnes and 6.6 billion USD in 2016, which was an increase of 4% in volume and 6% in value compared to 2015. China is the world leading producer of oysters with 87.6% of the weight and 78.5% of the value produced (FAO, 2018).

The main species of oysters produced in the world are Pacific cupped oyster (*Crassostrea gigas*) and European flat oyster (*Ostrea edulis*). Total production of Pacific cupped oyster and European flat oyster are 575.3 thousand tonnes, valued €1.17 billion in 2016. Republic of Korea, Japan and France are the leading producers of Pacific cupped oyster and European flat oyster covering 47%, 28% and 11% of the weight and 13%, 29% and 31% of the value.

The EU produced around 77 thousand tonnes, with a corresponding value of €422 million, in 2016. The EU produced 13% in weight and 36% in value of the global Pacific cupped oyster and European flat oyster production. In the EU, the main producer is France with 64 900 tonnes, followed by Ireland with 8 016 tonnes (FAO, 2018).

Table 3.10: Economic indicators for the EU oyster aquaculture: 2016.

Country	Number of enterprises	Total sales volume	Turnover	Employment	FTE	Average wage
	number	*tonnes*	*million €*	*number*	*number*	*thousand €*
Croatia	5	0.0	0.1	17	8	10.8
France	1,991	126.9	471.2	11,180	6,147	25.5
Ireland	153	10.1	44.2	1,294	598	24.0
Netherlands	19	3.3	15.5		48	74.6
Portugal	91	1.1	6.2	239	126	11.9
Spain	59	1.3	1.3	632	126	4.1
United Kingdom	81	2.2	7.4	288	202	
Total reported	***2,399***	***144.9***	***545.8***	***13,650***	***7,255***	***25.1***
Other non DCF		0.0	0.0			
Total EU		**144.9**	**545.7**			

Source: EU Member States DCF-EUMAP data submission and FAO, 2018

Reported data under the DCF shows that oyster aquaculture reached 144.9 thousand tonnes, which is a decrease of 7% compared to 2015 and a value of €545.7 million in 2016, which also corresponding to a decrease of 7% compared to 2015. France represents around 87% of the volume and value. Croatia has become the second largest European producer representing 11% of volume and 22% of value, ahead of Ireland especially focusing on oyster sales with high added value.

The number of enterprise farming oysters in EU reached 2 394, in 2016. Eighty-three percent of the enterprises are located in France, followed by Ireland (6.4%), Portugal (3.8%) and UK (3.4%). The enterprises employs 7 246 FTEs. Overall, France has a negative development in the sector, which influences on the total performance of this sector being the largest contributor. However, other European producers seem to have a stable or even increasing contribution from this sector.

This dependency on the availability of French data is also present on the following figure where the extent of the economic performance of the EU oyster aquaculture sector can be seen for 2016. The production of oysters is mainly on bottom. This segment represents 94% of the EU oyster turnover and 87% of the EU GVA.

In 2016, the EU oyster aquaculture gross value added reached more than €323 million, corresponding to a decrease of -3.4% compared to 2015. EBIT reached €96.8 million, increasing

+262% from 2015, and the positive economic performance is confirmed by a ROI of 5.3%, increasing 11.6 points from 2015. Nevertheless, it should be noted that the economic performance parameter ROI of the countries producing oysters is very heterogeneous.

Labour productivity was €44.8 thousand and equal to 2015. Capital productivity decreased to a level of 41% compared to 2015. The future expectations indicator (FEI) of the industry was negative (-0.4%), however this parameter is also showing large differences between countries.

Table 3.11: Economic Performance indicators for the EU oyster aquaculture: 2016.

Country	GVA	EBIT	ROI	Labour productivity	Capital productivity	Future Expectations Indicator
	million €	*million €*	*%*	*thousand €*	*%*	*%*
Croatia	0.1 ▲	0.0 ▼	1.8 ▼	15.8 ▲	12.2 ▲	-4.4 ▲
France	263.0 ▼	58.6 ▼	8.3 ▼	42.8 ▬	37.3 ▼	-0.7 ▼
Ireland	32.6 ▲	16.4 ▲	26.3 ▲	54.6 ▲	52.4 ▲	0.1 ▼
Netherlands	13.8 ▲	10.0 ▲	495.8 ▲	289.9 ▲	682.9 ▲	62.6 ▬
Portugal	5.7 ▲	4.1 ▲	370.4 ▲	45.4 ▲	514.0 ▲	25.7 ▼
Spain	0.9 ▼	0.3 ▬	16.4 ▲	7.1 ▼	44.1 ▲	4.9 ▲
United Kingdom	7.4 ▼	7.4 ▼		36.7 ▼		
Total EU	323.5 ▼	96.8 ▲	11.6 ▲	44.8 ▬	40.9 ▼	-0.4 ▼

Source: EU Member States DCF-EUMAP data submission, 2018

For 2015 and 2016, total operating costs have significantly decreased compared to 2014 and that led to an increase of profit and the highest net profit margin value in an 8-year period for 2016 (41.5%). The dominant costs of the EU oyster aquaculture sector for the years 2015 and 2016 years are wages and salaries (46% and 50%, respectively), followed by other operational costs (19% for 2015 and 24% for 2016) and livestock costs (19% for both years). Unpaid labour is almost halved from 2014 to 2016. The oyster sector due not have any feed cost because the feeding of oyster is exclusively of the nutrients available in the sea.

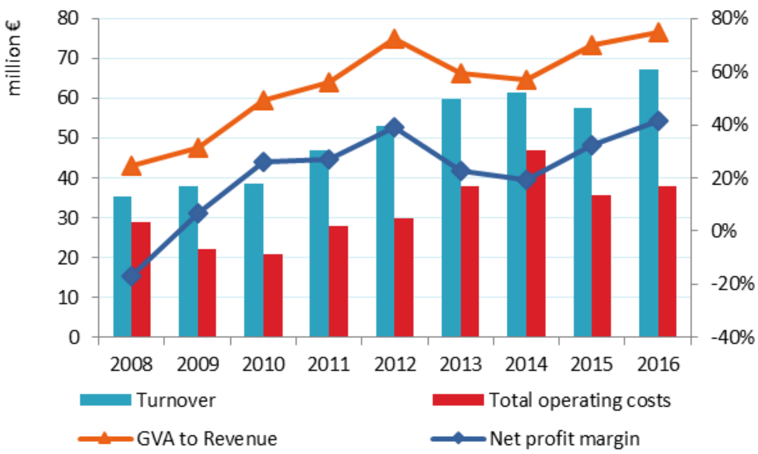


Figure 3.12: Economic performance indicators for oyster aquaculture: 2008-2016.

Source: EU Member States DCF-EUMAP data submission, 2018

The majority of the income and profits are generated in the oyster bottom segment, covering 88% of income and 87% of profit, respectively. The gross value added of this segment reached €274 million, and net profit margin reached more than €62 million in 2016. However, the highest net profit margin belongs to the oyster other segment with a net profit margin of 20% and 33% for 2015 and 2016, respectively. The oyster bottom segment only had a net profit margin of 2% in 2015, increasing to 12% in 2016. The net profit margin for oyster rafts have had a negative value trend since 2009, but improved significantly in 2016 as the results improved from -84% in 2015 to a negative value of -6% in 2016. GVA to revenue for oyster bottom and oyster other segments kept rising for 2015-2016 while it remained steady for oyster rafts.

The cost structure (including depreciation of capital) is very different between the segments. Three cost items characterize the oyster bottom segment: livestock costs, which represented 29% of the total costs, wages and salaries (20%) and consumption of capital (11%). For the other oyster segment, wage and salaries represent 42% of total cost. The most important cost item for oysters on rafts are wage and salaries covering 35%.

EU prices of cultured Pacific cupped oyster and European flat oyster show a common increasing trend. Concerning Pacific cupped oysters, the decrease in production translates into an increase in the sales price of 54% between 2010 and 2014. Before 2010, the data concerning the EU price of the European flat oyster must be used with caution do to the lack of data. While both Pacific cupped oyster and European flat oyster prices increased in 2016 with 6% and 3% compared to 2015, it should be noted that there was a significant price decrease for the Pacific oyster from 2014 to 2015. Nevertheless, EU prices continue to be more than double of the world prices.

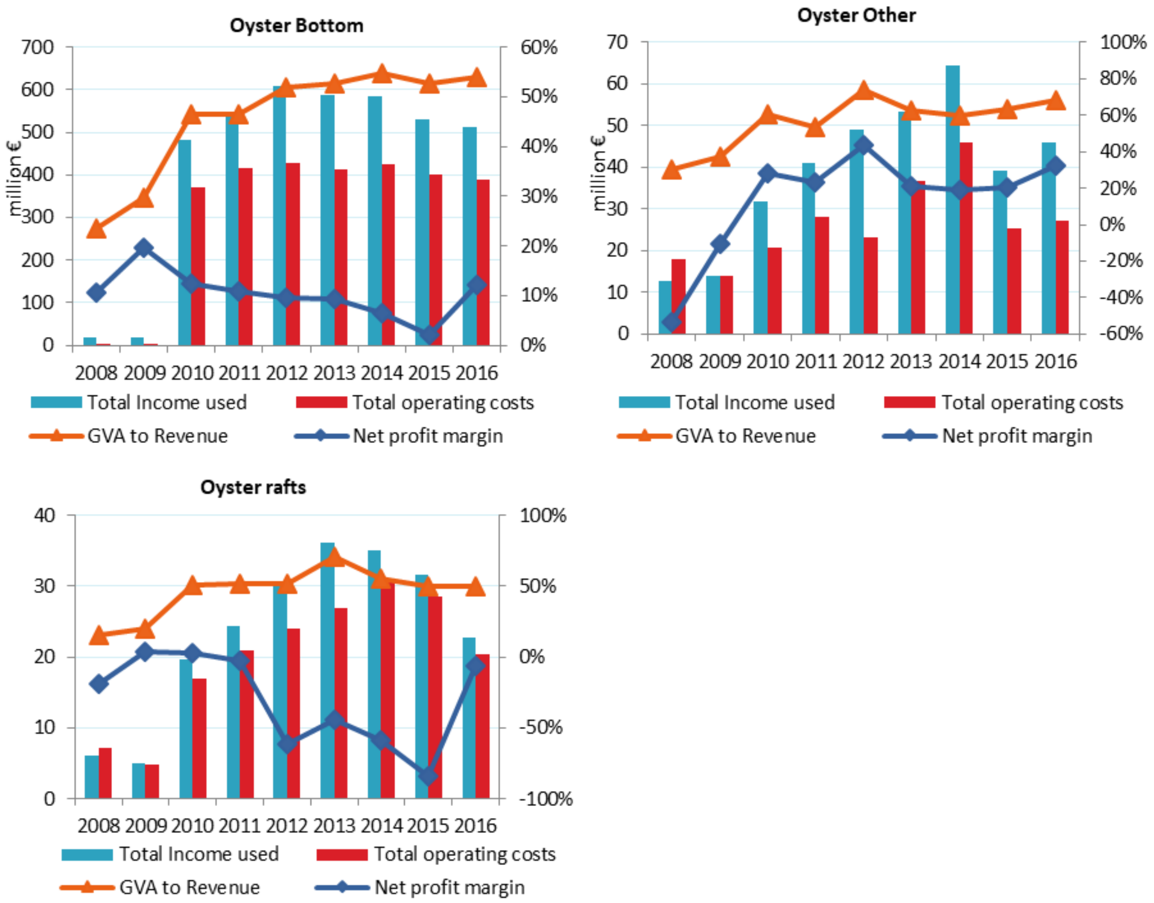


Figure 3.13: Development of economic performance for the EU oyster aquaculture: 2008-2016.

Source: EU Member States DCF-EUMAP data submission, 2018

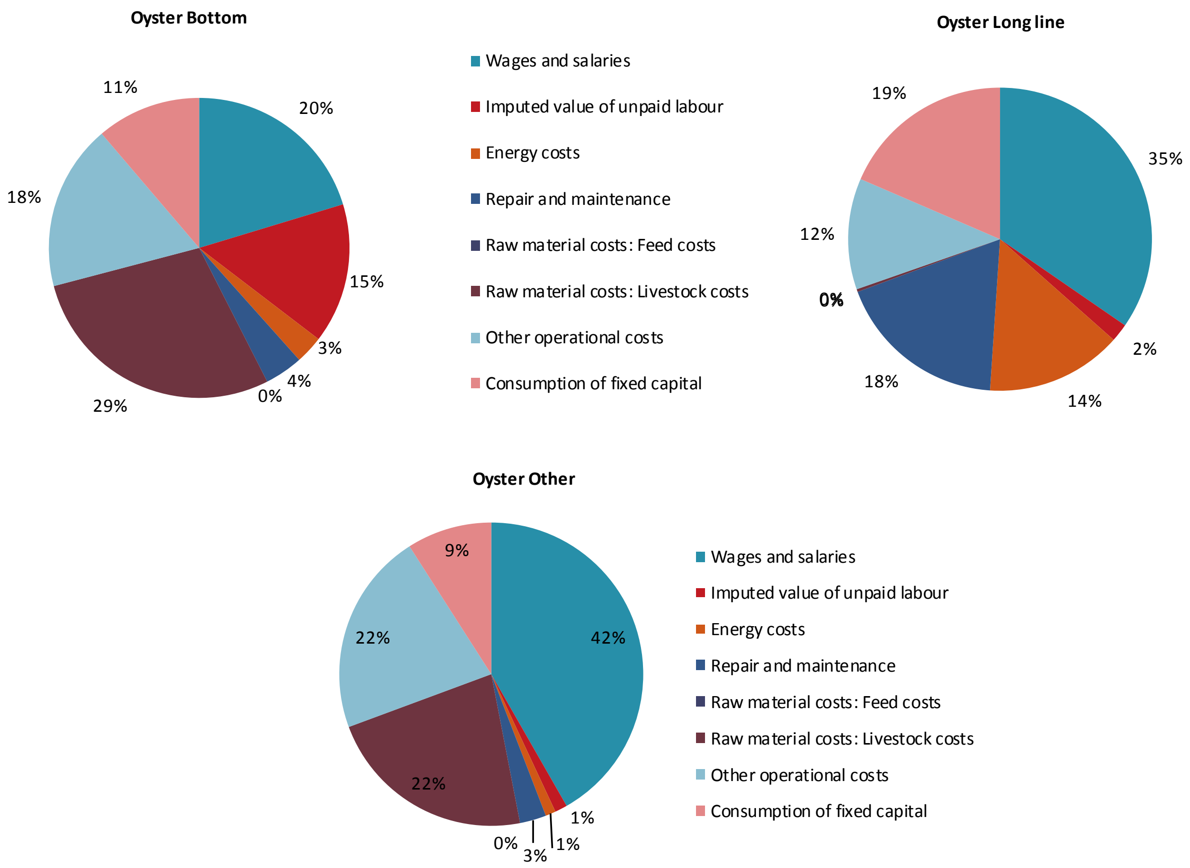


Figure 3.14: Costs breakdown for the EU oyster aquaculture: 2016.

Source: EU Member States DCF-EUMAP data submission, 2018

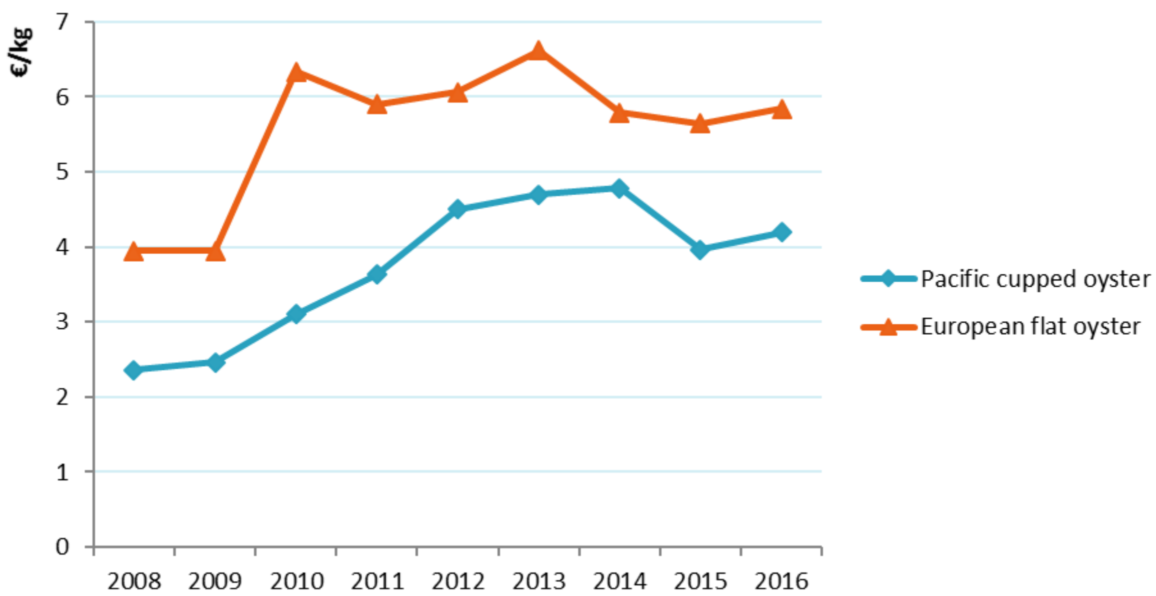


Figure 3.15: Price evolution of the main species of oyster group: 2008-2016.

Source: EU Member States DCF-EUMAP data submission, 2018

3.2.3 Clam

There are different species of clams and cockles produced in aquaculture: Japanese carpet shell, blood cockle, Japanese hard clam, Northern quahog, grooved carpet shell, common edible cockle, etc. The main clam species cultured in the EU are Japanese carpet shell (*Ruditapes philippinarum*) and grooved carpet shell (*Ruditapes decussatus*) (FAO, 2017).

Global clam production reached 5.54 million tonnes (+5.7%/2015) and USD 9.6 billion (+5.4%/2015) in 2016. China is the world leading producer of clams with 96% (5.3 million tonnes) of the weight and 94% of the value produced (FAO, 2017).

The three most important species of clams produced globally are Japanese carpet shell (*Ruditapes philippinarum*), Constricted tagelus (*Sinonovacula constricta*), and Blood clocke (*Anadara granosa*). Total production of Japanese carpet shell in 2016 was 4.2 million tonnes, valued USD 9.6 billion. China (74%), Italy and Republic of Korea are the world Japanese carpet shell leading producers covering 75% of the weight; while China and Italy covers 69% and 10% of the value (FAO, 2017).

Data reported under the DCF in 2016 shows that clam aquaculture in EU experienced a decline in its total production and value compared to 2015, with a production of 32.2 thousand tonnes corresponding to a value of almost €148 million. Among the European countries, Italy is the leading producer of clams and covers about 80% of European production. In 2016, the Italian production was 25 600 thousand tonnes, followed by Portugal with 3 618 thousand tonnes, and Spain with 2 945 tonnes (Table 3.14: 3.11).

Table 3.14: Economic indicators for the EU clam aquaculture: 2016.

Country	Number of enterprises	Total sales volume	Turnover	Employment	FTE	Average wage
	number	*tonnes*	*million €*	*number*	*number*	*thousand €*
Italy	176	25,606	92.4	2,633	741	38.0
Portugal	1,254	3,618	34.5	2,014	341	12.9
Spain	661	2,945	21.3	5,792	981	10.3
Total reported	***2,091***	***32,169***	***148.1***	***10,439***	***2,063***	***10.4***
Other non DCF		3	13.9			
Total EU		**32,172**	**162.1**			

Source: EU Member States DCF-EUMAP data submission and FAO, 2018

The collected data showed that at least 2 091 enterprises were producing clams in the EU. Looking at the number of companies, it is evident that in Portugal has the highest number. Almost 60% of these companies are located in Portugal and 31% in Spain. Furthermore, in Portugal, the most important segment (in terms of production weight and sales value), is the clam based on bottom farms producing Grooved Carpet Shell, in small areas of land in intertidal zone, usually with less than 1 hectare.

Referring to manpower, the clam sector employed 10 439 people. In Portugal and Spain, the employment corresponded to 1 322 FTEs. Part time workers make up an important part of this segment, since the number of FTEs only adds up to 20% of the numbers of employees in the segment. Portugal provided an average wage of €12.9 thousand. The legal enterprises are mostly small familiar units managed by the owner and their relatives. These micro farms have no organized accountant system. The average Spanish wage shows a lower value estimated at €10.3 thousand. This is significantly lower than the €21 thousand of average wage in the EU shellfish production. In Italy, wages and salaries are more than double compared to Spain and Portugal. The motivation is that a part of the salary is represented by the payment of the cost of the employed who work in the harvesting phases from natural clam seed shoals. In Italy, the clam sector has an important social role. The most productive area is in Northern Emilia Romagna and Veneto. In that area, many families base their economy on clam farms. Many businesses are made up of female members. The dynamic has allowed both the increase in the number of companies since the mid-1980s and the volume produced. Many women were first employed in the textile manufacturing sector, and then converted into the clam sector. Socially the work of women is widely recognized and paid on a par with that of men.

Figure 3.27 shows that after an increase of the GVA to revenue and net profit margin since 2012, the clam aquaculture sector has decreased in 2016 compared to 2015. While turnover decreased from €178 million in 2015 - the highest peak during 2008-2015 - to €148 million in 2016 (a 16% decrease), total operating costs remain stable.

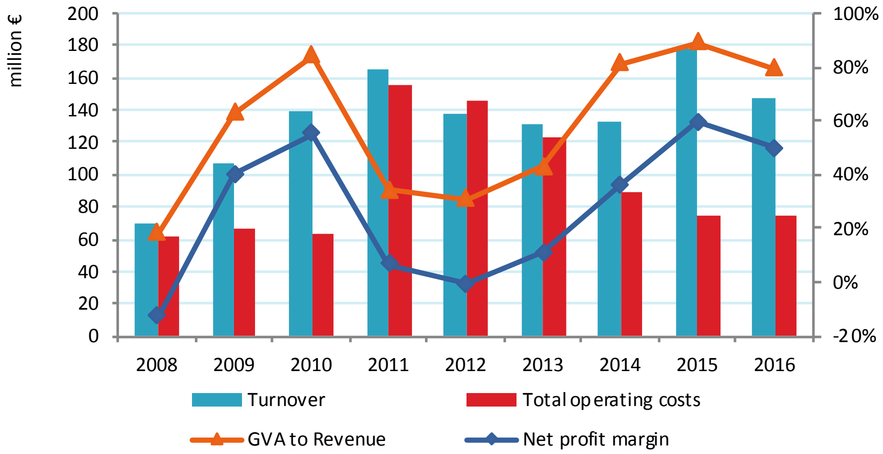


Figure3.16: Economic performance indicators for clam aquaculture: 2016.

Source: EU Member States DCF-EUMAP data submission, 2018

After a decrease in the net profit in 2011 and 2012, the economic performance of the clam economic activity has increased during 2014 and 2015. In 2016, the turnover decreased to €145 million. Total operational costs remain stable compared to 2015, resulting in a decreasing net profit margin.

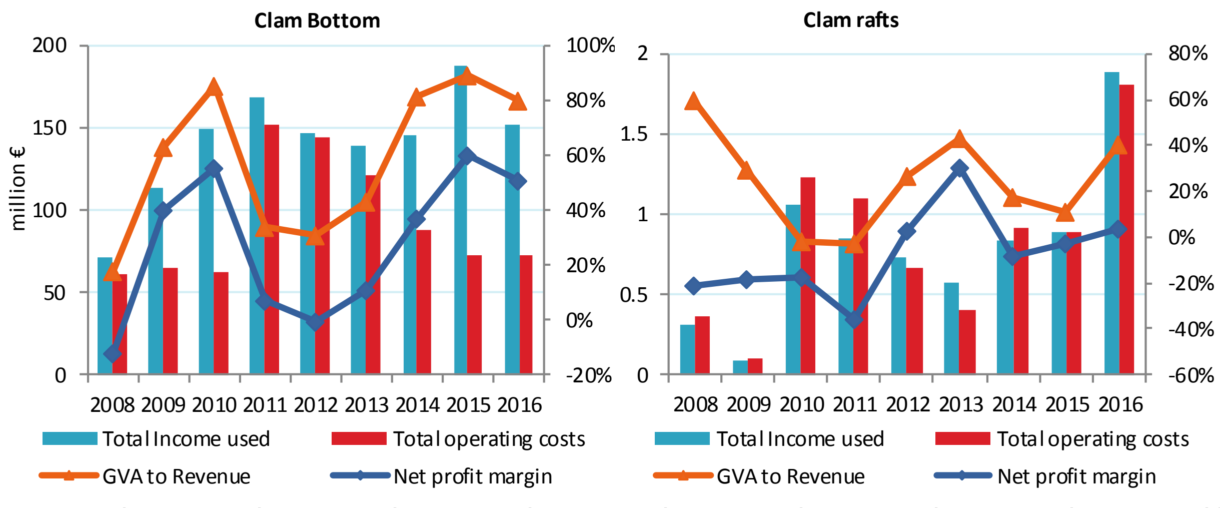


Figure 3.17: Economic performance indicators for clam aquaculture: 2008-2016.

Source: EU Member States DCF-EUMAP data submission, 2018

Compared to 2015, GVA to revenue, net profit margin and total income decreased in bottom clam segment compared 2015, while total operating costs remain stable. For clam rafts, all economic indicators show a positive trend, in particular total operating costs and total income, which present the highest peak of the time series.

The EU clam aquaculture gross value added reached €122 million; the EBIT was €77 million, and the sector had a positive ROI of 50%. Labour productivity reached €37.7 thousand. The capital productivity indicator strongly decreased from 162% in 2015 to 23.2% in 2016.

Table 3.15: Economic Performance indicators for the EU clam aquaculture: 2016.

Country	GVA	EBIT	ROI	Labour productivity	Capital productivity	Future Expectations Indicator
	million €	*million €*	*%*	*thousand €*	*%*	*%*
Italy	72.3	42.3	68.6	97.6	117.4	28.6
Portugal	33.7	29.3		98.8		
Spain	16.1	5.4	69.6	16.4	207.2	-9.2
Total EU	122.1	77.0	50.0	37.7	23.2	24.3

Source: EU Member States DCF-EUMAP data submission, 2018

The dominant costs of the EU clam aquaculture sector for the years 2015 and 2016 years are wages and salaries (46% and 50%, respectively), followed by other operational costs (19% for 2015 and 24% for 2016) and livestock costs (19% for both years). Unpaid labour is almost halved from 2014 to 2016. The energy cost (16.9%), repair and maintenance cost (13.7%) and finally livestock (11.6%) represent the other important items of operating costs. This cost structure indicates a very low capital and technology intensive sector.

When interpreting the costs of the clam segment it is important to understand the dynamics within the sector. The clam farm often has the legal form of a cooperative, including both fishermen fishing for seed (livestock) and the actual clam farmers. One part of the year fishermen provide input in terms of seed (livestock) to the farms. This actually means that the purchase of seed is registered as a labour cost and not a purchase of livestock.

Figure 3.30 show the operating costs for clam bottom and clam longline. Wages and salaries is the most important cost item for clam bottom (45%), whereas livestock costs are the most important for clam longline (40%). For clam longline the salaries and wages and unpaid labour accounts for 18% each. This indicates that the clam production activity is very labour intensive with less use of capital equipment.

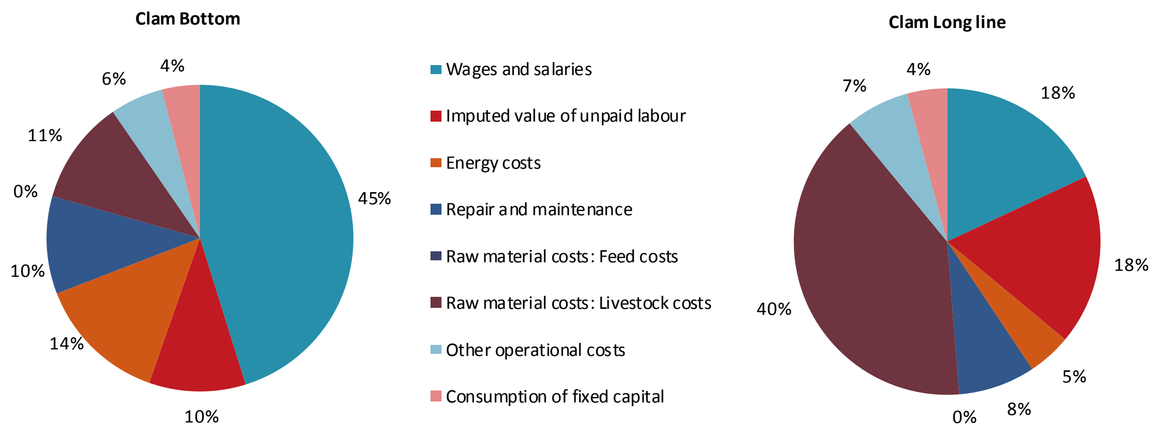


Figure 3.18: Costs breakdown for the EU clam aquaculture: 2016.

Source: EU Member States DCF-EUMAP data submission, 2018

EU prices (and world prices) of grooved carpet shell showed an increase during the period 2008 to 2010. Then during the 2011 and 2012 prices decreased. During 2013 and 2014 the prices slowly increase and more rapidly from 2014 to 2016 (€22.6 per kg), which is the highest price reported during the whole period.

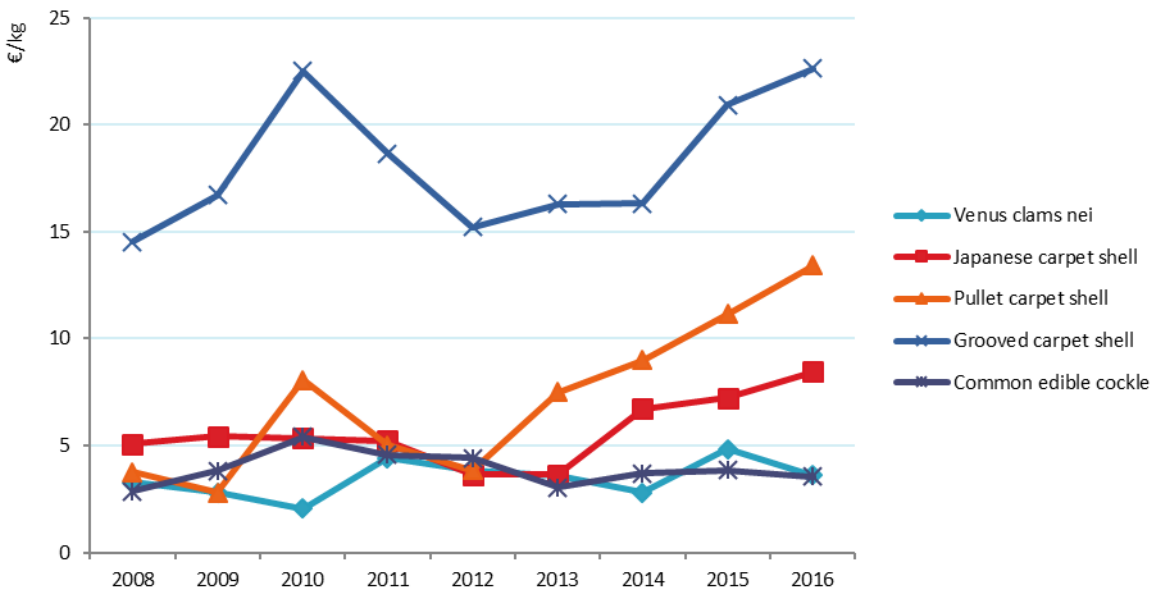


Figure 3.19: Price evolution of the main species of oyster group: 2008-2016.

Source: EU Member States DCF-EUMAP data submission, 2018

The price for grooved carpet shell reflects the characteristics of production. This species is reared in protected areas and the timing of growth is very similar to that of the natural life cycle. This production is perceived of high quality because it follows a natural growth. Production of this species is labour intensive rather than capital intensive. On the other hand, the *venus* clams price show an opposite evolution than the carpet shell, with a price €3.6 per kg. In this case, the species is suffering a reduction in its average prices since 2011 until the end of the period analysed. Both Pullet carpet shell and Japanese carpet shell experienced a constant increase since 2012 and 2013, respectively, with the highest prices achieved in 2016 (€13.4 per kg and €8.5 per kg). The decrease recorded in the sector is also linked to the introduction of the minimum sizes that could be marketed.

Outlook

In the clam segment, important milestones have been reached to mitigate conflicts with other anthropic activities that are located in the same coastal areas. In Italy, the regions in which clam aquaculture is mainly concentrated, have been obtained exclusive areas of nursery for the reproduction of the seeds, but the areas allocated exclusively to aquaculture and to *venericulture* have not yet been defined. As for mussels, even for clams, Italian producers are focusing on the enhancement of the product, through certifications of environmental sustainability. Investments in Italy have been realized with the EMFF 2014-2020 to strengthen vertical integration, to diversify the offer. Some Producer Organizations have started investments to acquire their own clam processing company, mussels. This integration can allow a widespread penetration in different target markets. Moreover, some new opportunities will be linked and generated by certified clam production because they come from sustainable fishing.

In Portugal, similarly to what is accessed in other EU MS, the investments in aquaculture are based on spatial planning, seeking not only to minimize possible conflicts with other users. They will favour environmental standards in the implementation of the physical structures, but, mainly, in the use of aquaculture production methods compatible with the protection and improvement of the environment. Investments to introduce improvements in management practices of production and marketing including through the intensification of new information and communication technologies are also encouraged. Structural modernisation is also being promoted within the current fisheries management plan.

3.2.4 *Other shellfish segments*

In 2016, the allocation of volume and value of other shellfish species is different from previous years, because shrimp production for the first time is dominating this segment.

The segmentation for the shellfish species include the Palaemonid shrimps, Danube crayfish, Great Atlantic scallop, Marine crabs, Indian white prawn and other marine shellfish. While Palaemonid shrimp is dominating in terms of production volume, Whiteleg shrimp is dominating the sales value.

Figure 3.30: Main species, produced in the other shellfish farming facilities: 2016.

Source: Eurostat, 2018

In terms of weight, the Palaemonid shrimp is the most important (43%), followed by Other marine shellfish (19%), Danube crayfish (13%), Great Atlantic scallop (10%), Marine crabs (8%) and Indian white prawn (7%).

In terms of value, the Whiteleg shrimp is the most important (39%), followed by the Palaemonid shrimp (26%), Other marine shellfish (17%), and Great Atlantic scallop (9%). The Danube crayfish and Atlantic ditch shrimp makes up the rest of the sales value corresponding to 6% and 3%, respectively.

The higher importance in terms of value shown for the Whiteleg shrimp is essentially because this specie fetches very high prices whereas the Palaemonid shrimp obtain low prices.

3.3 Freshwater aquaculture

The total volume of EU freshwater aquaculture sales was 304.8 thousand tonnes in 2016, generating a value of €1 billion. Compared to the EU marine sector the volume of the total sales from the freshwater enterprises was 28% lower, while the turnover was 62% less, in other words, the prices per kilogram tend to be much smaller.

Italy remains the largest contributor to the EU freshwater production covering 13% of the volume and 12% of the value. Other major producers are Denmark, France and Spain covering 11%, 9% and 6% of the total EU production volume, respectively.

Table 3.126: Economic indicators for the EU aquaculture freshwater subsector: 2016.

Country	Number of enterprises	Total sales volume	Turnover	Employment	FTE	Average wage
	number	*thousand tonnes*	*million €*	*number*	*number*	*thousand €*
Bulgaria	555	7.9	19.8	999	884	2.5
Croatia	43	4.0	7.9	998	559	9.2
Denmark	97	33.9	121.3	389	259	69.7
Finland	173	12.5	69.6	495	341	40.6
France	268	27.8	108.7	1,233	945	17.3
Greece	112	2.5	11.0	290	231	10.6
Ireland	6	0.7	2.0	23	19	37.0
Italy	146	40.9	122.5	594	112	143.7
Latvia	85	1.5	5.6	250	169	12.2
Malta	1	0.1	0.9	3	3	16.8
Portugal	6	0.7	1.9	32	28	15.4
Spain	183	18.4	62.5	932	704	21.2
Sweden	109	14.3	58.2	610	296	28.5
United Kingdom	216	14.4	57.7	740	571	18.1
Total reported	***2,000***	***179.6***	***649.7***	***7,588***	***5,122***	***21.8***
Other non DCF		125.2	353.5			
Total EU		**304.8**	**1,003.2**			

Source: EU Member States DCF-EUMAP data submission and FAO, 2018
*Note: Italian average wage is not reliable due to an underestimation of the FTE reported.

The economic performance of the freshwater sector is mainly dependent on the production of Rainbow trout and common carp covering 57% and 18% of total value in the freshwater segment (See Figure 3.31). The farming of these two species has some distinct economic and employment characteristics. Trout aquaculture production is mostly obtained from more intensive technologies, whereas carp producers use more extensive technologies.

There were more than 2 000 enterprises in the EU freshwater sector (excluding the landlocked countries). The sector employed around 7 600 people (Table 3.16), which approximately correspond to a bit more than 5 thousand FTEs. On average, each enterprise employed 4 persons and the average wage was around €22 thousand; however, the wage varies significantly across Member States. Salaries are dependent on the technique used and the species produced. The highest salaries were reported in Denmark and Finland, where intensive trout aquaculture dominates. The lowest salaries were paid in Bulgaria and Romania, where extensive carp production dominates.

Table 3.17: Economic Performance indicators for the EU aquaculture freshwater subsector: 2016.

Country	GVA	EBIT	ROI	Labour productivity	Capital productivity	Future Expectations Indicator
	million €	*million €*	*%*	*thousand €*	*%*	*%*
Bulgaria	10.4	9.3	26.0	11.8	29.0	5.6
Croatia	12.0	6.0	93.3	21.5	188.5	32.4
Denmark	29.5	4.7	3.0	114.1	18.6	1.0
Finland	12.9	1.3	1.3	56.8	13.4	-1.3
France	32.4	12.4	15.5	34.3	40.4	-1.2
Greece	6.1	3.0	20.5	26.4	41.2	0.0
Ireland	0.2	-0.4	-7.8	9.6	3.9	-3.0
Italy	50.4	31.1	17.3	449.8	28.0	33.7
Latvia	2.8	0.7	2.8	16.5	10.6	-4.5
Malta	0.3	0.3	83.0	107.5	105.0	-1.3
Portugal	0.4	-0.2	-9.2	12.6	17.7	37.9
Spain	15.7	-0.2	-0.3	22.3	22.8	-1.3
Sweden	31.3	20.4	33.1	117.4	50.9	-1.2
United Kingdom	15.5	3.5	14.6	27.1	64.0	-1.6
Total EU	219.9	91.9	7.6	35.1	28.7	0.7

Source: EU Member States DCF-EUMAP data submission, 2018
**Note: Italian labour productivity is not reliable due to an insufficient number of FTE reported.

The EU freshwater aquaculture sector generated €219 million in GVA in 2016, which corresponded to a 10% increase from 2015. Measured in terms of EBIT, profitability reached €91 million. Overall profitability measured in terms of ROI reached 7.6%. Labour productivity was on average €35 100 per FTE (Table 3.17).

Figure 3.31: Main species, produced in the EU MS excluding land lock countries freshwater farming facilities: 2018.
Source: FAO, 2018

Rainbow trout dominates this segment with 55% of the volume and 57% of the value of total EU production. The common carp is the second most important species with volume and value of 25% and 18%, respectively; production of European eel generated 6% of the value.

3.3.1 Trout

Global production of Rainbow trout (*Oncorhynchus mykiss*), increased during the 2008 - 2016 period from 518 thousand tonnes valued €1 952 million in 2008 to 717 thousand tonnes valued €3 080 million in 2016. Globally the leading producers are Iran, Turkey, Norway and Chile producing 23%, 15%, 12% and 12% of the total volume and 14%, 8%, 13% and 20% of the total value in 2016, respectively. The four leading countries covered 61% of the global volume and 55% of the global value (FAO 2018).

European production of Rainbow Trout decreased from 2008 to 2016 from 204 thousand tonnes valued €590 million in 2008 to 185 thousand tonnes valued at €615 million in 2016. The leading European producers are Italy, Denmark and France covering 19%, 17% and 14% of the total volume, respectively and 16% each of the total value, in 2016. In total, the three countries covered 50% of the total volume and 48% of the total value. For Sweden and Bulgaria there has been a considerably increased in the production volume since 2008, whereas the German and the French production volume have decreased.

The global share of volume covered by EU countries has decreased from 39% in 2008 to 26% in 2016. Accordingly, the global share of value for the EU countries has also decreased from 30% in 2008 to 20% in 2016.

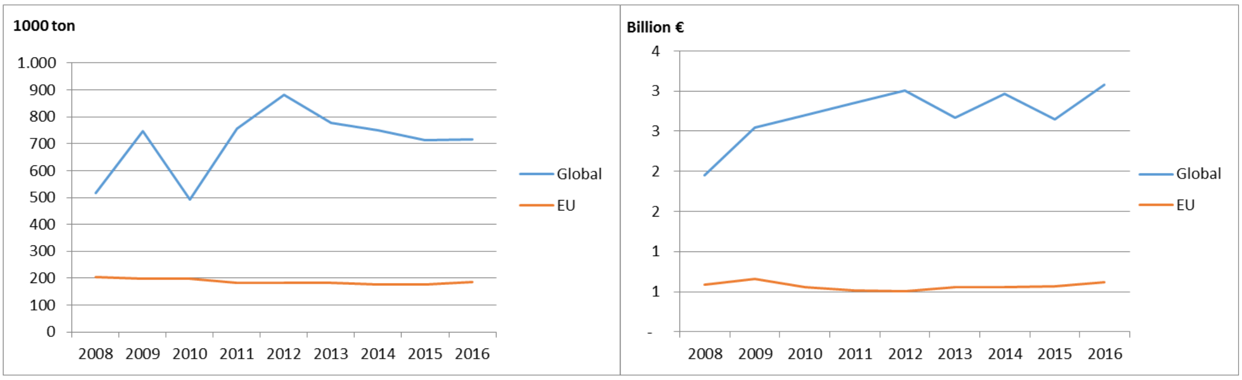


Figure3.32: Development of global and European production of trout: 2008 - 2016.

Source: FAO, 2018

The EU freshwater trout production reached 292.4 thousand tonnes valued at €692.5 million in 2016. The DCF data represented 78% of total EU28 sales volume and 76% of turnover. There is a large variation in freshwater trout production within the EU Member States. The total sales volume varied from 40 tonnes in Cyprus to about 41 thousand tonnes in Italy. The total turnover varied from almost €0.3 million in Cyprus to about €122.5 million in Italy, followed shortly by France with €108.7 million.

The numbers of enterprises engaged in trout production in the EU was 857. The enterprises employed 4 352 people, corresponding to 2 969 FTEs. The freshwater trout sector has an important component of part-time work (0.68 ratio between FTE and employment). There is a large variation in the average wages between the countries. The salaries varied from €2.8 thousand in Bulgaria to €72.2 thousand in Denmark.

In 2016, income and GVA in the trout sector was generated almost equally by the on-growing and combined segments, representing 47% and 53% of the income and 56% and 44% of the GVA, respectively. Positive EBIT and net profit were obtained in both segments. In economic terms, the hatcheries and nurseries segment has no significant economic importance. This is mainly because most of the activities related to hatcheries and nurseries are integrated in the combined segment.

Table 3:18: Economic indicators for the EU trout aquaculture: 2016.

Country	Number of enterprises	Total sales volume	Turnover	Employment	FTE	Average wage
	number	*thousand tonnes*	*million €*	*number*	*number*	*thousand €*
Bulgaria	91 ▲	3.8 ▲	11.2 ▬	256 ▲	242 ▲	2.8 ▲
Croatia	20 ▬	0.5 ▼	1.6 ▼	54 ▼	48 ▲	7.1 ▬
Denmark	88 ▼	30.2 ▼	102.2 ▬	307 ▲	204 ▼	72.2 ▼
Finland	78 ▼	12.4 ▼	67.0 ▲	414 ▼	322 ▲	40.4 ▬
France	268 ▬	27.8 ▬	108.7 ▬	1,233 ▬	945 ▬	17.3 ▼
Greece	62 ▲	2.1 ▲	6.9 ▲	164 ▲	120 ▼	9.1 ▼
Ireland	6 ▼	0.7 ▼	2.0 ▼	23 ▼	19 ▼	37.0 ▲
Italy	146 ▼	40.9 ▼	122.5 ▼	594 ▼		
Portugal	6 ▼	0.7 ▲	1.9 ▬	32 ▼	28 ▼	15.4 ▲
Spain	92 ▲	17.8 ▲	50.7 ▼	705 ▲	593 ▲	20.4 ▼
United Kingdom	144 ▼	14.2 ▼	53.4 ▼	570 ▼	449 ▼	23.0 ▼
Total reported	***857*** ▼	***151.0*** ▼	***528.1*** ▼	***4,352*** ▬	***2,969*** ▼	***27.8*** ▼
Other non DCF		41.4 ▲	164.4 ▲			
Total EU		**192.4** ▼	**692.5** ▬			

*Note: Italian labour productivity is not reliable due to an insufficient number of FTE reported.
Source: EU Member States DCF-EUMAP data submission and FAO, 2018

The reported DCF data shows that the trout sector has obtained a profit in 2016. The gross value added reached €142 million. EBIT reached more than €54 million, showing a positive economic performance confirmed by the ROI indicator of 7.2%. Labour productivity reached €38.0 thousand and capital productivity was 28.4%. The future expectations of the industry were -0.7%.

The economic performance in the different Members States shows large variation in the economic performance indicators. The GVA varied from about €0.2 million in Ireland to €50.4 million in Italy. The EBIT varied from -€2.9 million in Spain to €31.1 million in Italy. Labour productivity varied from around €9.6 thousand in Ireland to €122.9 thousand in Denmark. Capital productivity varied from 3.9% for Ireland to 96.7% for Greece. For the 10 Member States that produced freshwater trout only 2 reported a positive future expectations indicator.

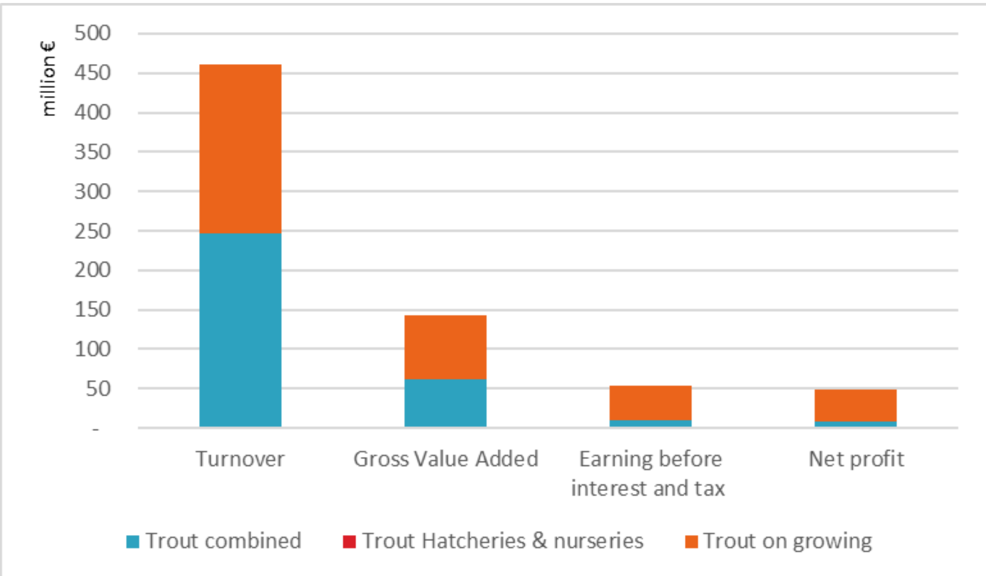


Figure 3.33: Economic performance indicators for trout aquaculture: 2016.

Source: EU Member States DCF-EUMAP data submission, 2018

Table 3:19: Economic Performance indicators for the EU trout aquaculture: 2016.

Country	GVA million €	EBIT million €	ROI %	Labour productivity thousand €	Capital productivity %	Future Expectations Indicator %
Bulgaria	6.3	5.2	35.3	26.2	43.4	-6.8
Croatia	0.8	0.7	12.6	15.9	14.5	-1.1
Denmark	25.1	5.5	4.8	122.9	22.0	-0.6
France	32.4	12.4	15.5	34.3	40.4	-1.2
Greece	4.8	3.6	73.4	39.8	96.7	-1.2
Ireland	0.2	-0.4	-7.8	9.6	3.9	-3.0
Italy	50.4	31.1	17.3	449.8	28.0	33.7
Portugal	0.4	-0.2	-9.2	12.6	17.7	37.9
Spain	10.7	-2.9	-5.8	18.1	21.1	-1.5
United Kingdom	11.2	-0.7	-3.1	24.9	46.3	-1.6
Total EU	142.2	54.3	7.2	38.0	28.4	-0.7

*Note: Italian labour productivity is not reliable due to an insufficient number of FTE reported.
Source: EU Member States DCF-EUMAP data submission, 2018

The figure below shows the economic performance indicators for trout aquaculture (all segments) for 2008-2016. In 2016 turnover declined by 8% to €343.8 million compared to 2015. Total operating costs have decreased by 17% compared to 2015 and that led to an increase of net profit margin from -2% in 2015 to almost 9% in 2016. GVA to revenue had decreased from 2013 to 2015 and in 2016 increased to 29%.

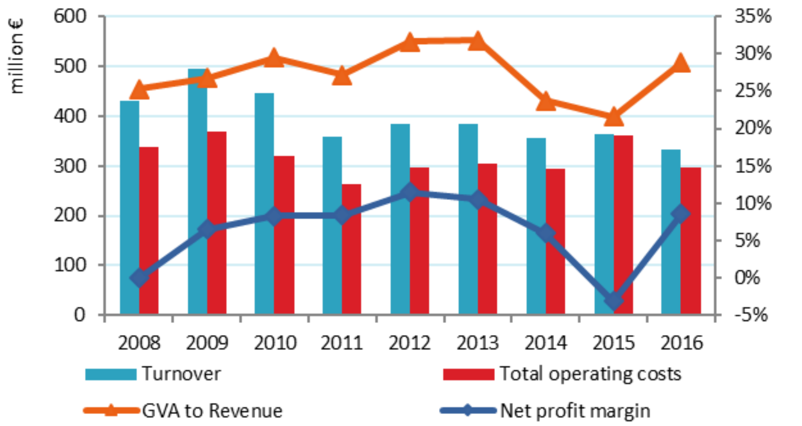


Figure 3.34: Economic performance indicators for trout aquaculture: 2008-2016.

Source: EU Member States DCF-EUMAP data submission, 2018

The two most important segments in freshwater trout aquaculture are the combined and on growing segment. Overall both segments had a positive net profit margin in 2016. The combined segment had a total income of €253.5 million and total operating costs of €233.6 million in 2016. The enterprises in the combined segment experienced an increase in GVA in 2013, but since then the GVA has slowly declined. The net profit margin has been slightly positive over the last four years and was 0% in 2015, but increased to 3% in 2016.

The economic performance of the on growing enterprises had its peak in 2012 and 2013. In 2016, the total income of this segment reached €231.7 million, whereas the total operating costs reached €223.5 million. The net profit margin has been decreasing from 2012 to 2015 but increased to 18% in 2016 due to lower operational costs. The GVA to revenue for this segment has furthermore increased from 2014 and reached 35% in 2016.

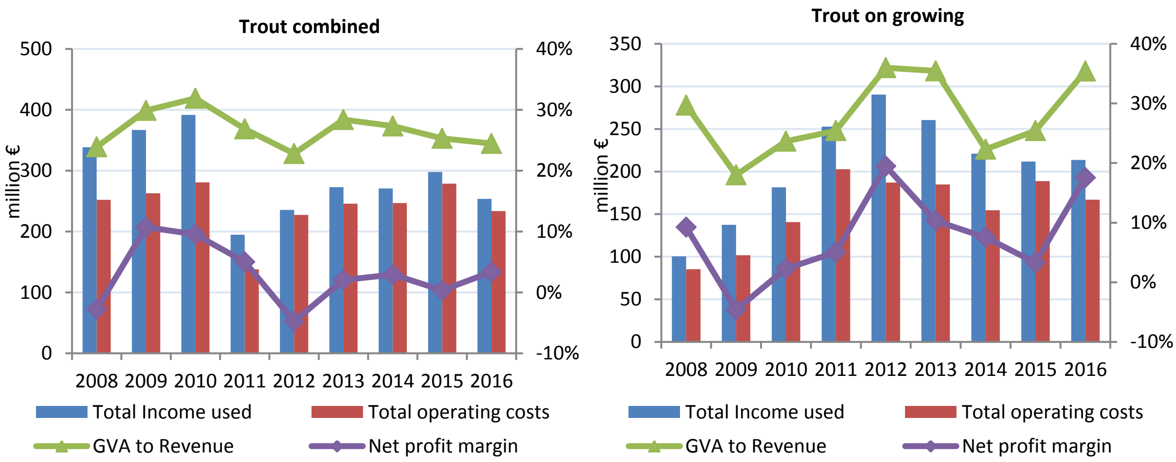


Figure 3.35: Development of economic performance for the EU trout aquaculture: 2008-2016.

Source: EU Member States DCF-EUMAP data submission, 2018

The most dominant costs of the freshwater trout sector are raw material (feed and livestock costs), which represented 55% of the total costs in the combined segment and 53% in the on growing segment. Other operational costs constitute followed with 17% for combined and 12% for on growing segment. The cost of energy is higher in the on growing sector than in the combined segment because most of the intensive production systems using recirculation are placed in this segment. Wages and salaries represented the same share of 15%, which also was the case for imputed value of labour (2%), and repair and maintenance (3%).

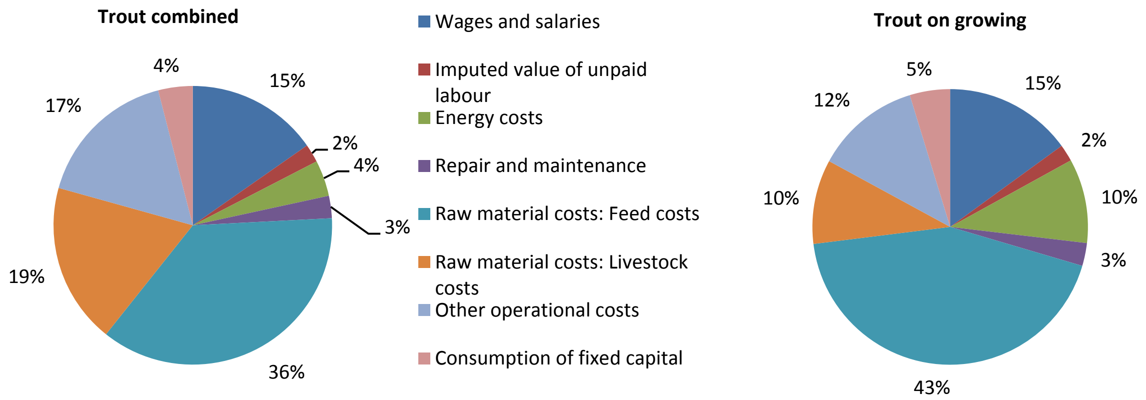


Figure 3.36: Costs breakdown for the EU trout aquaculture: 2016.

Source: EU Member States DCF-EUMAP data submission, 2018

The average prices of freshwater rainbow trout have shown an increasing trend from 2008-2014, with a minimum in 2008-2009 (€2.8 per kg) and a maximum in 2014 (€3.3 per kg). However, in 2015-2016 the average price decreased again to €2.8/kg. Market prices for sea trout are higher than for freshwater rainbow trout, because this price follows the salmon price. The average price for sea trout fluctuated but the overall trend is positive. The minimum price reached in 2009 (€3.2 per kg) and the maximum in 2015 (€7 per kg). In 2016, the price for sea trout declined by 4% to €6.7 per kg.

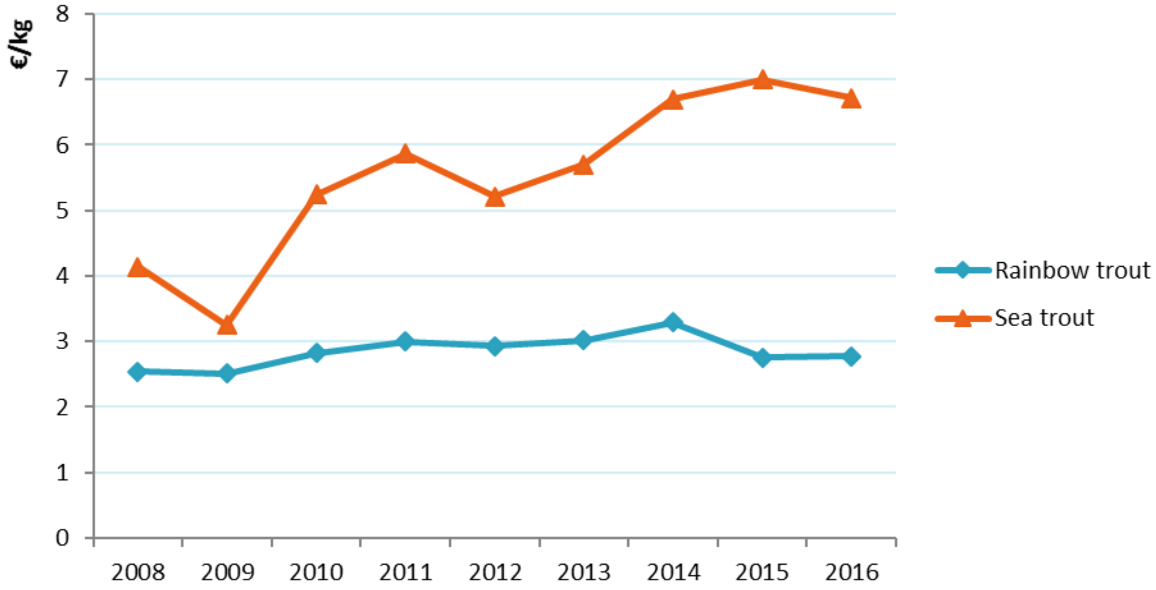


Figure 3.20: Price evolution of the main species of trout group: 2008-2016.

Source: EU Member States DCF-EUMAP data submission, 2018

3.3.2 Carp

Global production of carp increased from 13 515 thousand tonnes in 2008 to 19 370 thousand tonnes in 2016. Globally, the leading producers are China, Bangladesh and Russia covering 93%, 2% and 0.6%, respectively of the produced volume in 2016. The three leading countries produced more than 95% of the global volume. (FAO 2018).

European production of Common carp increased from 82 thousand tonnes valued €154 million in 2008 to 85 thousand tonnes valued at €176 million in 2016. The leading producers within EU are Poland, Czech Republic and Hungary producing 23.5%, 23% and 14% of the total volume in 2016, respectively. Combined the three countries Poland, Czech Republic and Hungary produced 60% of the total volume and 63% of the total value in 2016.

Various species of carp are produced in the EU. The main species produced by weight are common carp (*Cyprinus carpio*), bighead carp (*Hypophthalmichthys nobilis*), grass carp (*Ctenopharyngodon idellus*), silver carp (*Hypophthalmichthys molitrix*), and crucian carp (*Carassius carassius*), in 2016.

Common carp is the oldest freshwater species in European aquaculture (FAO 2018). Carp farming dates back to Roman times. Later, the Carolingians supported systematically the construction and maintenance of carp ponds in the medieval era (Füllner *et al.* 2007, Mück 2013). In particular, the Franconian royal courts and the order of the Cistercians played a central role in the domestication of carp and the development of fish farming techniques in Central and Eastern Europe. Indeed, it is one of the few aquaculture species with different breeding lines established (Füllner *et al.* 2017).

Common carp is the main species produced in EU by quantities. In 1989, the production topped with more than 100 000 tonnes. Since then the production has declined and amounted to 78 000 tonnes in 2015 (EUMOFA 2016). Common carp is mainly farmed in the Eastern Europe countries. Czech Republic and Poland are the main producers; each providing a quarter of the total EU production in 2015. Production in Poland has fluctuated around 18 000 tonnes over the 20 last years. The production in Germany was only a quarter of the earlier production reaching 5 000 tonnes in 2015 (FEAP 2016, Eurostat).

With the exception of the Czech Republic, EU production of common carp are produced for domestic markets. Poland is the main European market for live carp, with a consumption of more than 21 000 tonnes and imports reaching €5.6 million, of which 96 % were live carp. The Czech Republic and Hungary were its main suppliers with 54% and 30% of total imports in value, respectively. The domestic demand in Poland has a strong seasonal peak at Christmas time due to catholic culture. Germany is also a main importer of carp. In 2015, more than 2 600 tonnes were imported (German Federal Office for Agriculture and Food, BLE 2017). The imports amounted to about €5 million in 2015, of which 93% were live carp. Although, there is a range of different processed carp products, the tradition is still to buy fresh slaughtered carp or even live carp that can be prepared at home.

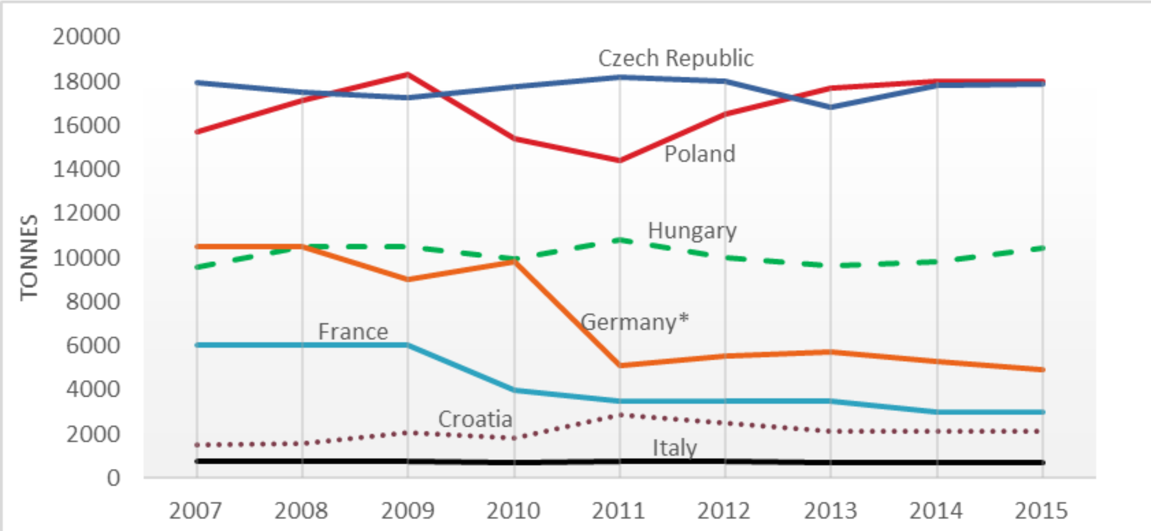


Figure 3.37: Quantities of common carp by main producers in EU (in tonnes) 2007-2015

* The "decrease" in German carp production is caused by changed survey methods in 2011.

Source: Federation of European Aquaculture Producers, FEAP 2016.

Due to the lack of freshwater aquaculture data reported under the DCF, especially for landlocked countries, which is also the main carp producing countries, it is difficult to give a detailed picture of the EU carp aquaculture sector. Based on the submitted information it is only possible to analyse four countries, which are included in the Table 3.20. The Polish and Romanian data were excluded because they were only partially available. Therefore, the total sales volume and turnover are retrieved from FAO combined with the available DCF data. The following countries were included in the table as "Other none DCF" using FAO data: Austria, Czech Republic, France, Germany, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. These country make up for 92% of the total turnover and total sales volume. In 2016, the EU aquaculture sector consisted of 585 registered enterprises, with a total sales volume of 7.3 thousand tonnes according to reported DCF data, which is definitely an underestimation of the real number of farms and sales. The majority of the enterprises (87%) were situated in Bulgaria and Spain. In 2016, the carp segment employed 1 829 people corresponding to 1 155 FTEs (Table 3.20). DCF and FAO data show a total sales volume of 88.1 thousand tonnes, including 80.8 thousand tonnes from 'Other non DCF countries'. Total turnover was €183.8 million including €168.5 million from FAO data.

The expert working group was not able to analyse and evaluate the overall performance of the carp sector by segments due to the limited data and due to differences in segmentation within DCF and EU MAP. Therefore, the situation for carp production is presented as one aggregated segment. The average wage in the segment was €6.8 thousand in 2016 and decreased compared to 2015 (€7.3 thousand) but is higher compared with 2014 (€6.1 thousand). Table 3.21 only includes data for Bulgaria, Croatia and Spain.

Table 3.20: Economic indicators for the EU carp aquaculture: 2016.

Country	Number of enterprises	Total sales volume	Turnover	Employment	FTE	Average wage
	number	*tonnes*	*million €*	*number*	*number*	*thousand €*
Bulgaria	421	3.5	5.1	116	514	2.5
Croatia	23	3.6	6.3	148	507	9.5
Spain	86	0.1	0.4	327	49	6.8
United Kingdom	55	0.2	3.5	44	85	
Total reported	***585***	***7.3***	***15.3***	***1829***	***1155***	***6.8***
Other (non DCF)		80.8	168.5			
Total EU		**81.0**	**172.4**			

Source: EU Member States DCF-EUMAP data submission and FAO, 2018

In terms of economic indicators, the amount of GVA, EBIT and Labour productivity generated by EU carp aquaculture sector in 2016 was €10.7 million, €5.4 million and €19 thousand, respectively, as can be seen in Table 3.21. ROI and Capital productivity achieved 402.4% and 790% in the same year.

Table 3.21: Economic performance indicators for selected EU carp aquaculture: 2016.

Country	GVA	EBIT	ROI	Labour productivity	Capital productivity	Future Expectations Indicator
	million €	*million €*	*%*	*thousand €*	*%*	*%*
Bulgaria	1.4	1.1	12.3	2.8	15.9	1.4
Croatia	11.3	5.3	465.6	22.1	991.2	187.3
Spain	-0.6	0.1	63.2	-12.5	-290.2	-3.0
Total EU	10.7	5.4	402.4	19.0	790.0	157.4

Source: EU Member States DCF-EUMAP data submission, 2018

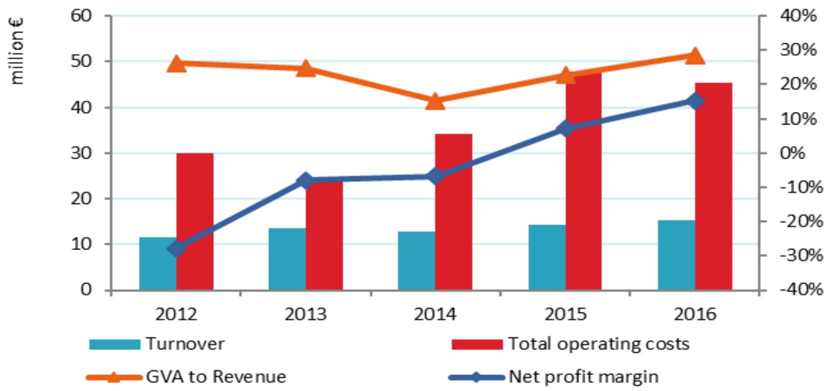


Figure 21.38: Economic performance indicators for carp aquaculture: 2012-2016.
Source: EU Member States DCF-EUMAP data submission, 2018

From the data provided to DCF it could be stated that carp aquaculture is very extensive as feed cost in the segment were only 10% of the total cost structure. The largest part of costs according to the provided data were other operational costs, which covered 62% of the total costs. Wages and salaries represented the second largest cost with 12 % of the total cost. Consumption of fixed capital represented 10% of the total. Energy costs and the rest of the costs were not important in terms of total costs, comprising no more than 2%.

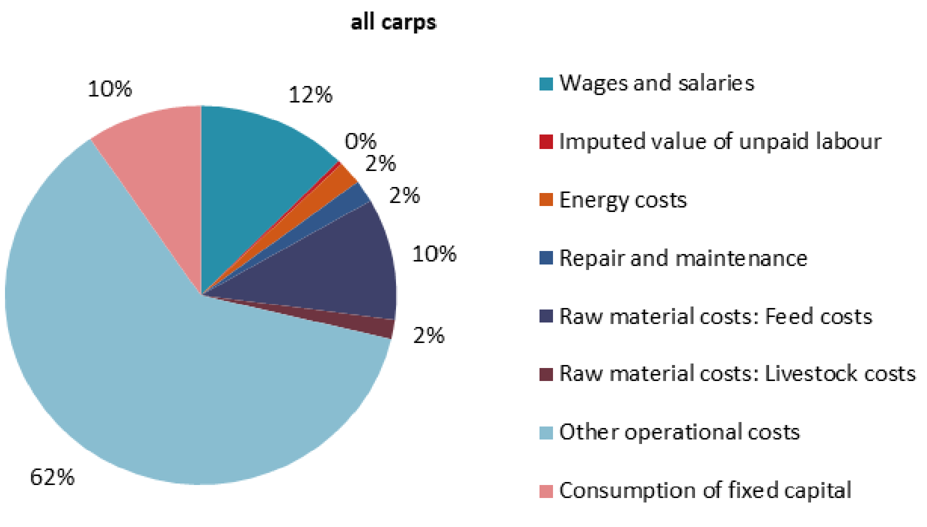


Figure 3.39: Costs breakdown for the EU carp aquaculture: 2016.
Source: EU Member States DCF-EUMAP data submission, 2018

The price for cultured common carp shows a decreasing trend, as illustrated in Figure 3.40. This is in line with world prices for carp (FAO). The price on common carp in EU is almost twice as high as the price on the world market. These price differences are likely to reflect the difference between European and Asian consumer income, and the incorporation of lower value cyprinid species (big head carp, silver carp and grass carp) within the world price for carp.

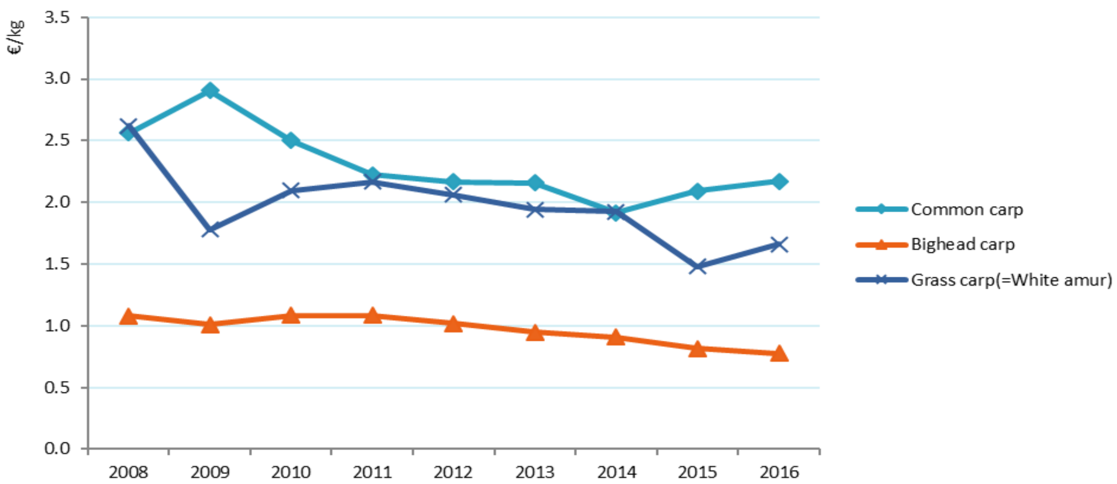


Figure 3.40: Price evolution of the main species of carp group: 2008-2016.
Source: EU Member States DCF-EUMAP data submission, 2018

3.3.3 *Other fresh water species*

Figure 3.3.1 shows the most important remaining fresh water species produced in the EU. European eel and North African catfish are the most important in terms of volume contributing with 24% and 24%, respectively. In terms of value European eel and Sturgeons represent 25% and 18%, respectively.

In total, the production was 19.8 tonnes, valued €133.7 million in 2016. The main contributors to the other fresh water species segment were The Netherlands, Germany and Poland with reported volume 4.9, 3.7, and 2.4 tonnes, respectively. The main contributors in terms of turnover were Germany, Italy and The Netherlands with the produced value €29.6, €24.9 and €22.4 million, respectively.

The average first-sale price for the main species within this segment was €8.4 for European eel, €19.5 for Sturgeons and €1.7 for North African catfish per Kg.

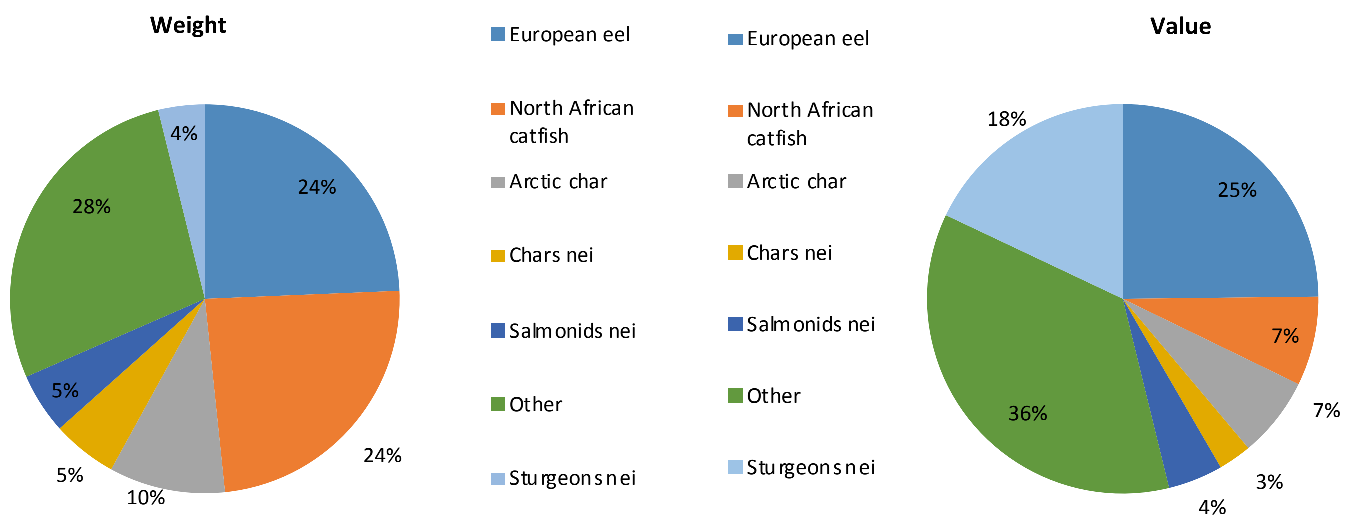


Figure 3.41: Main species produced in the EU Member States for Other freshwater species group: 2016.
Source: Eurostat, 2018

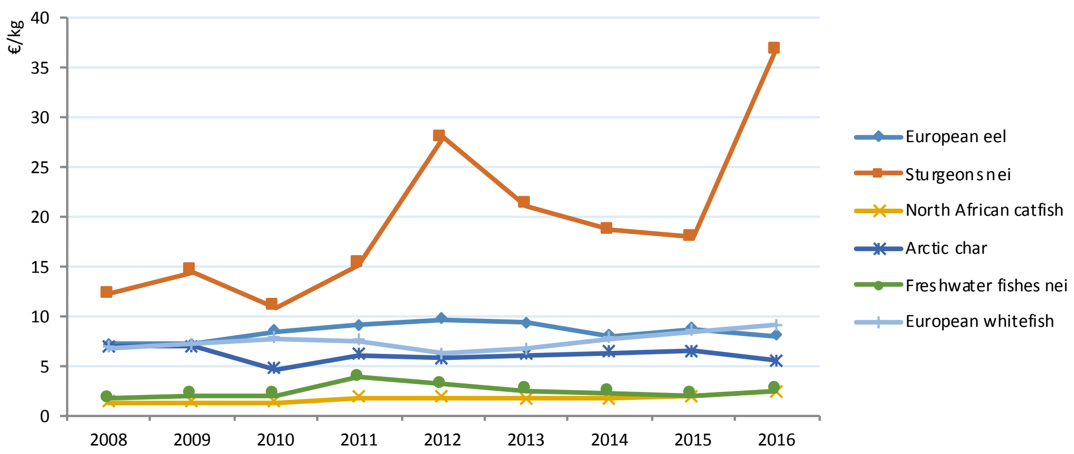


Figure 3.42: Price evolution of the main species in the EU Member States of Other freshwater species group: 2008-2016.
Source: Eurostat, 2018

3.4 Algae (aquatic plants)

According to the Commission Implementation Decision (EU) 2016/1251 segmentation, set out in Table 9, seaweed production is to be reported under the EUMAP data collection framework. However, no data on algae (seaweeds + microalgae) segments were reported in the 2018 data call.

The algae aquaculture production, although still small for most of the EU-28 countries, is an expanding sector boosted in the recent years by the increase in the demand of algae biomass for a variety of applications (e.g. food, nutraceuticals, cosmetics, biomaterials, bioremediation).

Data on algae aquaculture production for the EU-28 countries are available in the Eurostat and FAO databases. Discrepancies can be found between these two data sources in respect to some of the countries production (as an example, total 2008-2016 algae production in Denmark was, according to the FAO database, 7101.5 tonnes wet weight while in EUROSTAT was 19.8 tonnes wet weight). This lack of robustness of available underlying data prevents a comprehensive analysis of the current situation and a reliable projection of future trends for the algae aquaculture sector.

The analysis presented in this section is based on the data available from the Eurostat database and does not include data from Germany (due to confidentiality issues).

According to the available data, algae aquaculture biomass production at the EU-28 level increased since 2010, with reported values above 125 tonnes wet weight from 2014 onwards.

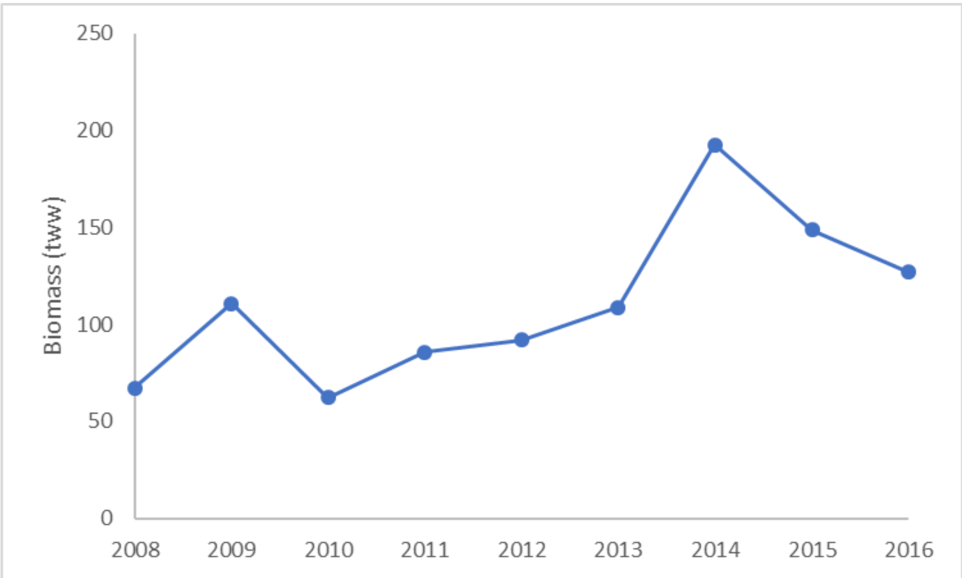


Figure 1: Temporal evolution of EU-28 algae aquaculture biomass production (tonnes wet weight, 2008-2016).
Source: Eurostat, 2018
Data for 2016 include a projected production for France (no data available yet) based on the average of the production 2008-2015.

EU-28 algae aquaculture is mainly supplied by French and Irish seaweed production. Denmark and Portugal also produce seaweeds while Spain produces both microalgae and seaweed. Greek´s production is based on Spirulina sp. and, Bulgaria´s production based on microalgae. However, a mapping of the algae industry in Europe conducted by JRC showed that seaweed aquaculture production is also occurring in Sweden and The Netherlands while many more countries than reported produce microalgae (e.g. The Netherlands, Portugal, France, Germany, Italy, etc.).

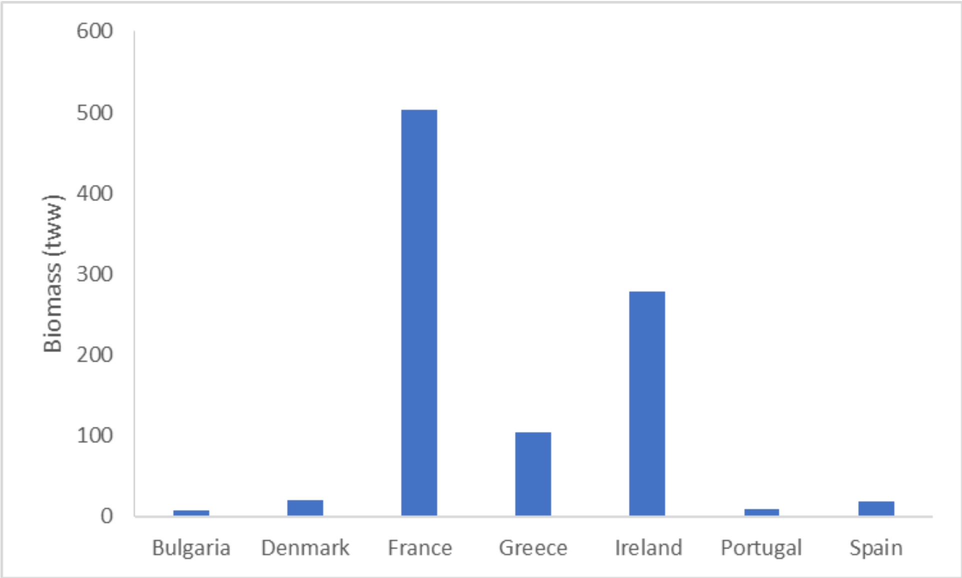


Figure 2: Total EU-28 algae aquaculture production by country, between 2008 and 2016

Source: Eurostat, 2018

The current EU-28 aquaculture algae production is overlooked because of the incomplete data reporting compared to the real production volumes. For the available algae production related databases (FAO, Eurostat) there is a lack of reporting for some of the algae producing Member States, no consistent reporting across years, no reporting for some groups of organisms (microalgae production is not listed for most of the countries), no harmonization on aggregation rules for the groups of species reported and variability on some of the production values between databases.

The EUMAP data collection segmentation does not include microalgae. Additionally, production methods currently listed under seaweed production are incomplete for seaweeds while including a mix of methods not applicable to algae production or specific for microalgae.

Under the EUMAP data collection framework the expert group recommend Member States to report their national seaweed production values in the next reporting cycle (to the lowest level of disaggregation possible if not colliding with confidentiality). The expert group also recommend a change in the segmentation categories listed for algae in a future revision of the regulatory framework in order to include microalgae and adapt the listing of producing methods to the algae sector specificities.

4 National chapters

4.1 Austria

Austria is a landlocked country producing only freshwater aquaculture products. The freshwater data collection is not mandatory under the DCF and optionally in EU-MAP, and landlocked countries are therefore not requested to provide economic data for this report.

Production volume and value

The Austrian aquaculture sector produced 3.5 thousand tonnes in 2016 and the estimated production value was €20 million (Eurostat, 2016). Austria doesn't have marine or shellfish aquaculture production.

The total weight of production in last four years of analysed period is stable. In 2016 the total weight was absolutely stable compared to 2015 and increased by 30% compared over the period 2008-2015. The value of the production in 2016 increased by 2% compared to 2015 and 21% compared over the period 2008-2015. The development over the last 9 years shows an increase in production, while the value seems to be driven mostly by the species with the highest prices. The value of production reached the highest level in 2010, then decreased until 2012 and since then it has been increasing.

From 2011, where data for hatcheries and nurseries was provided for the first time there is a significant increase in 2016 with the amount of 21 million units, which is 78% higher than the amount in 2015.

Table 4.1.1 Production and sales for Austria: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 15-16	Develop. 2016/(08-15)
Production weight (thousand tonnes)	***2.1***	***2.1***	***2.2***	***2.7***	***2.9***	***2.9***	***3.0***	***3.5***	***3.5***	***0%***	***30%***
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Freshwater	2.1	2.1	2.2	2.7	2.9	2.9	3.0	3.5	3.5	*0%*	*30%*
Production value (million €)	***12.7***	***13.9***	***20.4***	***16.5***	***14.6***	***16.5***	***18.2***	***19.7***	***20.0***	***2%***	***21%***
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Freshwater	12.7	13.9	20.4	16.5	14.6	16.5	18.2	19.7	20.0	*2%*	*21%*
Hatcheries & nurseries (million units)	***0***	***0***	***0***	***10***	***9***	***0***	***10***	***12***	***21***	***78%***	***306%***
Eggs	0	0	0	0	0	0	0	0	0	*0%*	*0%*
Juveniles	0	0	0	10	9	0	10	12	21	*78%*	*306%*

SOURCE: EUROSTAT

Main segments

Rainbow trout remain the main species produced by the Austrian aquaculture sector representing 35% of the total weight and 38% of the total value of production in 2016. Other important species are common carp covering 17% of the weight and 15% of the value and brook trout accounting for 14% of the weight and 11% of the value.

Figure 4.1.1 Main species in terms of weight and value in Austrian production: 2016.
Source: EUROSTAT

Almost all aquaculture prices have had a similar trend over the period 2008 to 2016, except the price of the Sea trout, which was €37.7 per kilogram in 2010 decreased significantly to €7.7 in 2015. The most stable prices in the last years were the prices of brook trout and common carp. In general, the prices of the 5 main species were stable during the last years.

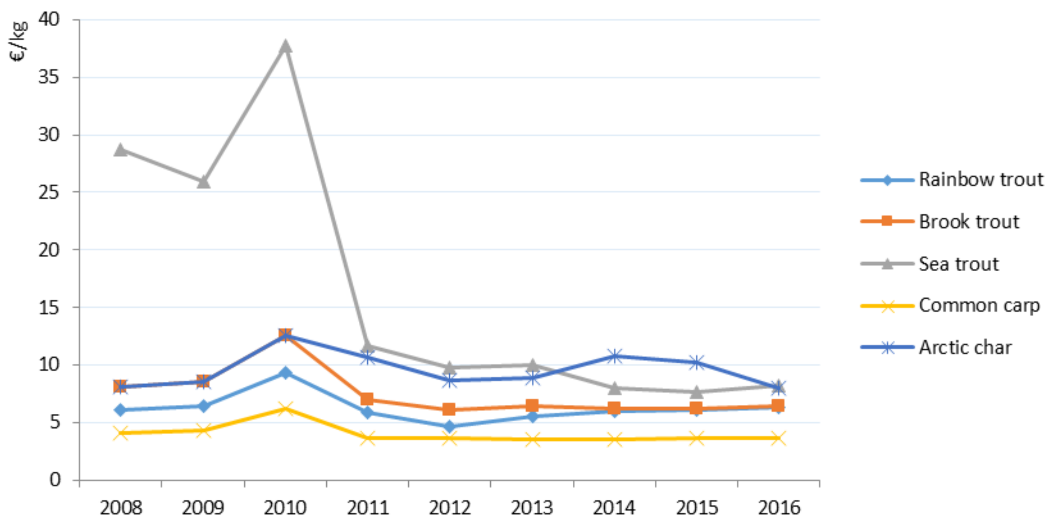


Figure 4.1.2 Average prices for the main species produced in Austria: 2008-2016.
Source: EUROSTAT

4.1.1 Data Coverage and Data Quality

Austria is a landlocked country producing only freshwater aquaculture products. The freshwater data collection is not mandatory under the DCF and optionally in EU-MAP, so landlocked countries are therefore not requested to provide economic data for this report. Data for the Austrian aquaculture sector is therefore provided by Eurostat.

4.2 Belgium

Although not landlocked, Belgium only produces freshwater aquaculture products. The freshwater data collection is not mandatory under the DCF, and therefore Belgium is not obliged to provide economic data for this report. The analysis below is based on the EUROSTAT data. However, EUROSTAT does not provide information for volume for this country in 2010, 2015 and 2016 and for the value of production in the years 2010, 2014, 2015 and 2016. This is due to a low number of producers and the data is therefore considered to be confidential.

Production volume and value

The main product of the Belgian aquaculture sector is rainbow trout, and from 2010 this is the only species in the EUROSTAT data with a total production of 175 tonnes in 2014.

Table 4.2.1 Production and sales for Belgium: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 15-16	Develop. 2016/(08-15)
Production weight (thousand tonnes)	***0,1***	***0,6***	***0,0***	***0,1***	***0,2***	***0,2***	***0,2***	***0,0***	***0,0***		
Marine	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		
Shellfish	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		
Freshwater	0,1	0,6	0,0	0,1	0,2	0,2	0,2	0,0	0,0		
Production value (million €)	***0,7***	***4,2***	***0,0***	***0,4***	***1,0***	***0,7***	***0,0***	***0,0***	***0,0***		
Marine	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		
Shellfish	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		
Freshwater	0,7	4,2	0,0	0,4	1,0	0,7	0,0	0,0	0,0		
Hatcheries & nurseries (million units)	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***		
Eggs	0	0	0	0	0	0	0	0	0		
Juveniles	0	0	0	0	0	0	0	0	0		

SOURCE: EUROSTAT

Data retrieved from the FAO database on aquaculture production indicate that the production in Belgium was below 50 tonnes in 2016.

4.2.1 Data Coverage and Data Quality

Belgium only produces freshwater aquaculture products. The freshwater data collection is not mandatory under the DCF and landlocked countries are therefore not requested to provide economic data for this report.

4.3 Bulgaria

4.3.1 Production and sales

The aquaculture sector in Bulgaria could be characterized as stable over the period 2008-2012 and after 2013 the sales volume increased rapidly. In 2016 the total sales weight and value were double compared to 2008.

In 2008, the turnover from sales was €10.5 million and in 2016 the turnover has increased by 70% compared to the period 2008-2015 and amounted €21 million. Compared to 2015, the turnover in 2016 increased by 22%. The total sales volume in 2016 increased by 91% over the period 2008-2015 and was 9.5 thousand tonnes. Compared to 2015, the total sales volume in 2016 increased by 33%.

Table 4.7.1 shows that despite the decline in the volume of total sales during the period 2008-2012, the situation in the last four years is getting better. Sales volume in 2016 is 196% higher than in 2009 (which is the year with the smallest amount of sales from the beginning of data collection in Bulgaria). There has been an increase in the sales volume in freshwater and shellfish sectors. The values of sales weight and sales value for hatcheries and nurseries sector remain zero since it is not a popular stand-alone activity in the aquaculture sector in Bulgaria, but it should be noted that some of the enterprises are producing eggs and fingerlings for their own uses.

The situation is similar with the total sales value - there is a decrease in the period 2008-2011. After 2012, there is a positive trend in the value of sales and in 2016 it is 153% higher compared to the value in 2009.

Table 4.3.1 Production and sales for Bulgaria: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/(08-15)
Sales weight (thousand tonnes)	*4.5*	*3.2*	*3.8*	*3.9*	*4.3*	*6.2*	*6.8*	*7.1*	*9.5*	*33%*	*91%*
Marine		0.0		0.0	0.0	0.0	0.0	0.0	0.0	*-100%*	*-100%*
Shellfish	0.6	0.3	0.5	0.6	0.8	1.0	1.3	1.5	1.6	*10%*	*98%*
Freshwater	3.9	2.9	3.3	3.3	3.5	5.2	5.5	5.6	7.9	*40%*	*90%*
Hatcheries & nurseries					0.0	0.0	0.0				
Sales value (million €)	*10.5*	*8.3*	*9.6*	*10.5*	*11.0*	*14.7*	*17.2*	*17.3*	*21.0*	*22%*	*70%*
Marine		0.0		0.0	0.0	0.0	0.0	0.0	0.0	*-100%*	*-100%*
Shellfish	0.2	0.3	0.4	0.5	0.6	0.9	1.0	1.3	1.2	*-9%*	*80%*
Freshwater	10.3	8.0	9.2	9.9	10.3	13.8	16.1	16.0	19.8	*24%*	*70%*
Hatcheries & nurseries					0.0	0.0	0.0	0.0	0.0		*0%*

Source: EU Member States DCF data submission

4.3.2 Industry structure and employment

In 2016, Bulgaria had 557 active aquaculture enterprises with 5 or less employees, 21 enterprises with 6-10 employees and 10 enterprises with more than 10 employees. Total employment in 2016 was 1 046 jobs, corresponding to 970 FTEs. The level of employment decreased between 2009 and 2012, but increased in the period 2013 - 2016. Among the possible reasons for these fluctuations is the unstable economic situation in the country. The number of enterprises in 2016 with less than five employees has increased by 4% compared with 2015, while the number of enterprises with 6-10 employees and more than 10 employees decreased by 22% and 17% respectively compared to 2015. The average wage in 2016 decreased by 17% compared to 2015, but it was 14% more than the average for the period 2008-2015.

The employment trends, regarding the gender, did not include the data for 2015 and 2016, because based on the new EU-MAP templates it is not in the part of the tables anymore, but Bulgaria continues to collect this data and it will be provided if it is included in the templates again. The mean wage in the sector decreased in the last 2 years. Total FTEs in 2016 increased with 17% compared to 2015 and with 27% compared to the average for the period 2008-2015.

Table 4.3.2 Structure of the Bulgarian aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Develop m. 2016/ (08-15)
Structure (number)											
Total enterprises	*274*	*336*	*347*	*388*	*163*	*317*	*354*	*575*	*588*	*2%*	*71%*
<=5 employees	241	316	339	377	151	283	318	536	557	*4%*	*74%*
6-10 employees	25	13	4	7	8	25	30	27	21	*-22%*	*21%*
>10 employees	8	7	4	4	4	9	6	12	10	*-17%*	*48%*
Employment (number)											
Total employees	*1 110*	*1 375*	*436*	*470*	*454*	*777*	*924*	*1 013*	*1 046*	*3%*	*28%*
Male employees	801	930	374	419	345	624	821				
Female employees	309	445	62	51	109	153	103				
FTE	1 110	1 375	436	470	454	756	679	830	970	*17%*	*27%*
Male FTE	801	930	374	419	345	613	605				
Female FTE	309	445	62	51	109	143	74				
Indicators											
FTE per enterprise	4.1	4.1	1.3	1.2	2.8	2.4	1.9	1.4	1.6	*14%*	*-31%*
Average wage (thousand €)	1.8	2.1	1.2	1.4	2.2	2.3	3.3	3.0	2.5	*-17%*	*14%*
Labour productivity (thousand €)	-9.7	-12.1	17.3	18.1	19.6	12.2	17.0	15.1	11.3	*-25%*	*17%*

Source: EU Member States DCF data submission

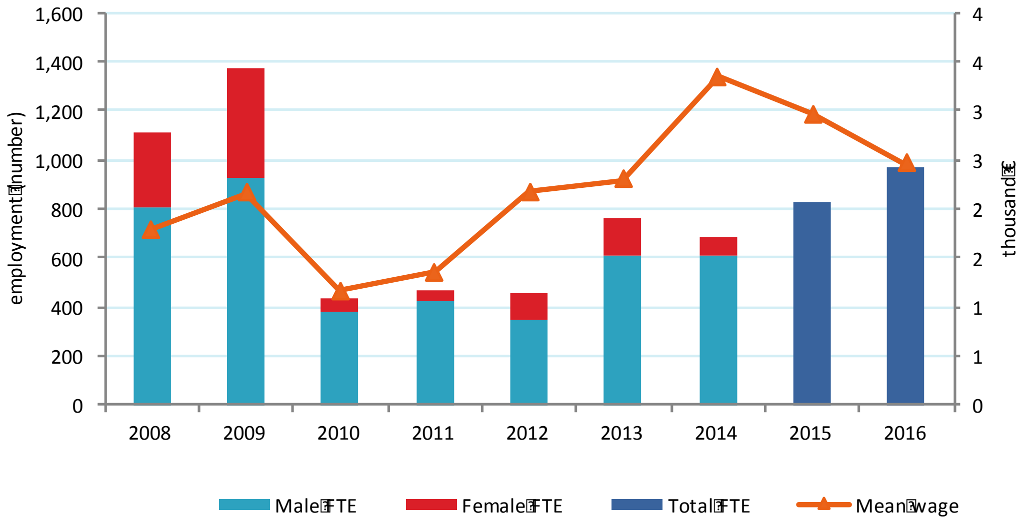


Figure 4.3.1 Employment trends for Bulgaria: 2008-2016.
Source: EU Member States DCF data submission

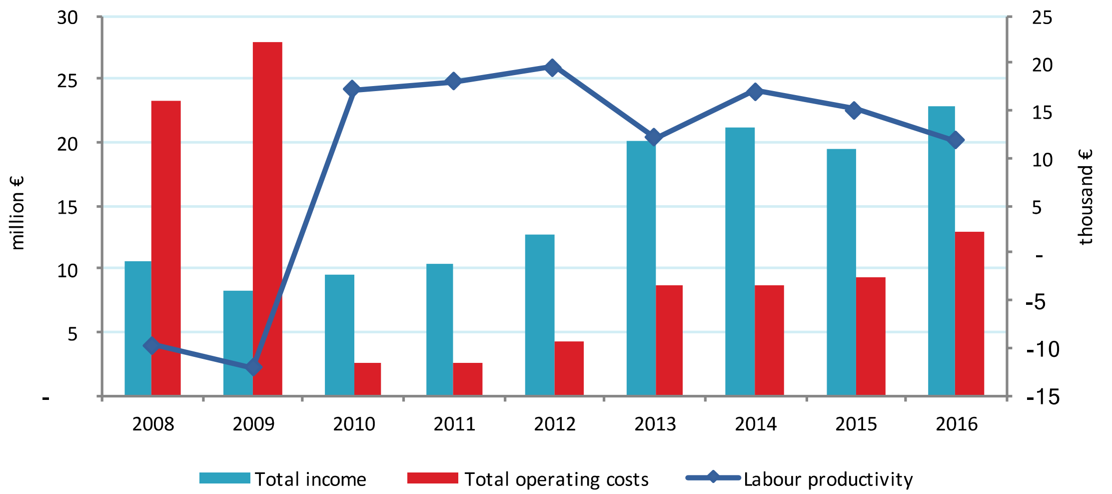


Figure 4.3.2 Income, costs, wages and labour productivity trends for Bulgaria: 2008-2016.

Source: EU Member States DCF data submission

The total income in 2016 has increased compared to 2015 and to the average for 2008-2015. The total operating costs have importantly decreased between 2009 and 2010, but after 2010 their value is increasing proportionally to the increase of the total income and in 2016 their value is 38% higher than in 2015. Labour productivity is rather unstable for the whole period 2008-2016.

4.3.3 Economic performance

The economic performance of Bulgarian aquaculture sector has deteriorated between 2008 and 2010, but in the last years, the situation significantly improves. The amount of total income generated by the Bulgarian aquaculture sector in 2016 was €21.1 million. The Total income value in 2016 increased by 17% compared to 2015, and it is 62% higher than the average value for the period 2008-2015. The largest part of the income remained from the turnover from sales, which represented 92%, followed by other income, which was 4%. The income from subsidies in 2016 increased compared to 2015. Unlike the turnover for 2016, which was 22% higher than in 2015, the other income decreased by 53%.

The total operating costs by the Bulgarian aquaculture sector in 2016 were €13 million and represented 57% of the total income. The total operating costs in 2016 increased by 19% compared to the average of the period 2008-2015. The largest expenditure item in 2016 was raw material: feed costs with €6.7 million and wages and salaries with €2.3 million (Table 4.3.3). Expenditures for other operational costs, raw material: livestock costs and raw material: feed costs in 2016 increased by 121%, 79% and 52% compared to 2015, respectively.

Table 4.3.3 Economic performance of the Bulgarian aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	% of total income	Change 2016-15	Development 2016/(2008-15)
Income (million €)												
Turnover	10.5	8.3	9.6	10.5	11.0	14.7	17.2	17.3	21.0	*92%*	*22%*	*70%*
Other income	0.0	0.0	0.0	0.0	1.3	1.4	0.8	2.2	1.0	*4%*	*-53%*	*46%*
Subsidies	0.0	0.0	0.0	0.0	0.5	4.0	3.1	0.0	0.7	*3%*		*-27%*
Total income	*10.5*	*8.3*	*9.6*	*10.5*	*12.7*	*20.1*	*21.1*	*19.5*	*22.8*	*100%*	*17%*	*62%*
Expenditures (million €)												
Wages and salaries	1.8	2.5	0.4	0.6	0.9	1.6	2.0	2.2	2.3	*10%*	*5%*	*55%*
Imputed value of unpaid labour	0.1	0.5	0.1	0.1	0.1	0.1	0.2	0.2	0.2	*1%*	*-30%*	*-13%*
Energy costs	0.4	0.4	0.1	0.1	0.1	0.6	0.5	0.6	0.5	*2%*	*-10%*	*59%*
Repair and maintenance	0.4	0.4	0.2	0.1	0.3	1.4	0.4	0.6	0.6	*3%*	*2%*	*33%*
Raw material: Feed costs	3.0	3.5	1.5	1.4	2.0	3.4	4.1	4.4	6.7	*30%*	*52%*	*131%*
Raw material: Livestock costs	16.5	19.5	0.3	0.4	0.9	0.7	0.8	0.7	1.3	*6%*	*79%*	*-74%*
Other operational costs	1.0	1.0	0.1	0.0	0.0	0.9	0.6	0.6	1.3	*6%*	*121%*	*150%*
Total operating costs	*23.2*	*27.8*	*2.6*	*2.6*	*4.3*	*8.7*	*8.6*	*9.4*	*13.0*	*57%*	*38%*	*19%*
Capital Costs (million €)												
Depreciation of capital	0.6	0.7	0.3	0.3	0.8	0.9	2.6	4.3	4.7	*20%*	*7%*	*254%*
Financial costs, net	1.6	1.5	0.2	0.3	0.3	0.3	0.5	0.0	3.0	*13%*		*401%*
Extraordinary costs, net	0.2	0.2	0.0	0.0	0.1	0.6	0.3					
Capital Value (million €)												
Total value of assets	38.2	26.0	6.6	6.5	15.8	16.7	26.3	40.8	42.1	*185%*	*3%*	*91%*
Net Investments	5.3	1.5	0.8	1.2	2.8	5.1	2.7	3.6	5.8	*26%*	*62%*	*101%*
Debt	28.2	35.9	2.0	2.7	4.9	6.8	9.4	9.1	9.2	*41%*	*1%*	*-25%*
Input & Production (thousand tonnes)												
Raw material: Feed	7.2	9.3	10.8	0.9	2.9	12.3	14.0	8.8	10.7		*21%*	*29%*
Raw material: Livestock	7.2	7.9	0.9	1.2	1.7	14.5	10.0	1.0	0.8		*-19%*	*-85%*
Performance Indicators (million €)												
Gross Value Added	-10.7	-16.6	7.5	8.5	8.9	9.2	11.6	12.5	11.5	*51%*	*-8%*	*200%*
Operating cash flow	-12.7	-19.6	7.0	7.8	8.4	11.4	12.4	12.3	14.0	*61%*	*13%*	*312%*
Earning before interest and tax	-13.3	-20.3	6.7	7.6	7.6	10.6	9.8	8.0	9.3	*41%*	*16%*	*348%*
Net profit	-15.0	-21.8	6.5	7.2	7.3	10.2	9.3	8.0	6.3	*28%*	*-21%*	*327%*
Capital productivity (%)	-28.1	-64.0	113.6	131.4	56.4	55.2	44.0	30.6	27.4		*-11%*	*-35%*
Return on investment (%)	-34.9	-78.2	101.9	117.0	48.0	63.5	37.4	19.6	22.1		*13%*	*-35%*
Future Expectation Indicator (%)	12.3	3.2	7.8	14.2	12.9	25.7	0.2	-1.8	2.8		*251%*	*-70%*

Source: EU Member States DCF data submission

According to capital cost, depreciation of capital is the main cost with the amount of €4.7 million. In 2016, the depreciation of capital increased by 7% compared to 2015, and by 254% over the period 2008-2015. In regards to capital value, the total value of assets and debt are the main costs with the amount of €42.1 million and €9.2 million, respectively. The total value of assets in 2016 increased by 3% compared to 2015, and by 91% compared to the average of the period 2008-2015. Debt remained stable in the period 2014-2016, but in 2016 decreased by 25% compared to the average of the period 2008-2015.

The amount of raw material volume: feed and raw material volume: livestock in 2016 were 10.7 thousand tonnes and 0.8 thousand tonnes respectively. Raw material volume: feed in 2016 increased by 21% compared to 2015, and 29% over the period 2008-2015. Raw material volume: livestock in 2016 decreased by 19% compared to 2015, and with 85% compared over the period 2008-2015.

The GVA generated by the Bulgarian aquaculture sector was €11.5 million in 2016, representing 51% of the total income. The GVA in 2016 decreased by 8% compared to 2015 but increased by 200% compared to the period 2008-2015. The operating cash flow amounted, in 2016, to €14.0 million, increased by 13% compared to 2015 and by 312% compared to the average for the period 2008-2015. EBIT was equal to €9.3 million in 2016 and increased by 16% compared to 2015. The net profit generated by the Bulgarian aquaculture sector in 2016 was €6.3 million and decreased by 21% compared to 2015.

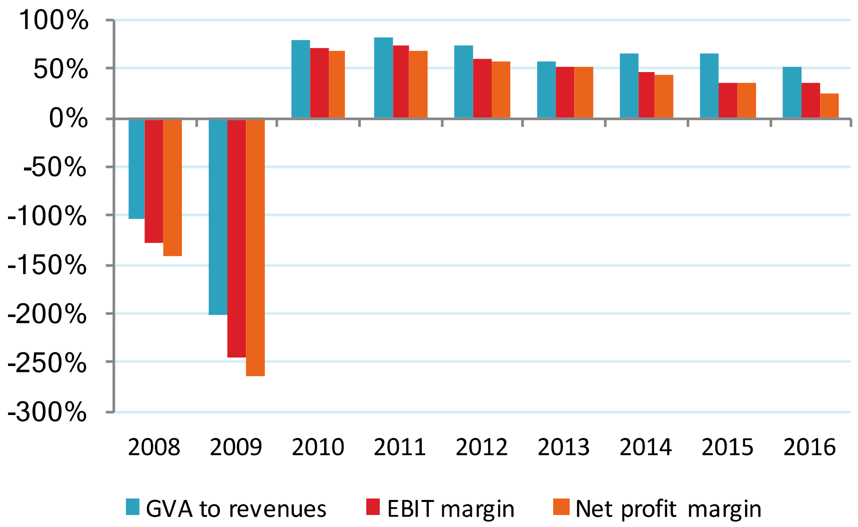


Figure 4.3.3 Economic performance for Bulgaria: 2008-2016
Source: EU Member States DCF data submission

4.3.4 Main species produced and economic performance by segment

The segments with highest economic and social importance in 2016 were trout cages, trout on growing, carp on-growing and mussel long line. In terms of net profit, the most valuable one was the trout cages segment. The largest segment, regarding sales volume and the number of enterprises was carp on growing. In terms of value of the sales, the one that generated the biggest turnover was the trout cages followed by trout on growing.

Figure 4.3.4 Main species in terms of weight and value in Bulgarian production: 2016.
Source: EU Member States DCF data submission

In terms of sales volume, the volume of the rainbow trout represented 38% of the total sales volume of Bulgarian aquaculture sector in 2016, followed by common carp (19%) and Mediterranean mussel (17%). Turnover from rainbow trout represents 51% of the total turnover in the same year, followed by common carp (17%), African catfish (14%) and others (12%).

The average price of rainbow trout was €3.88/kg in 2015. In 2016 average price decreased by 23% and amounted €2.99/kg. The average price of common carp was stable - €1.98/kg in 2014 and 2015, and €1.97 in 2016. The average price of Mediterranean mussel was €0.89/kg in 2015 and decreased by 17%, so in 2016 it was €0.74/kg.

The economic performance of four Bulgarian segments is shown in Figure 4.3.6 and Table 4.3.4. The data provided the time series for the detailed economic data started is from 2012 to 2016, because before 2012 the questionnaires for data collection were anonymous and voluntary, so data could not be divided into segments.

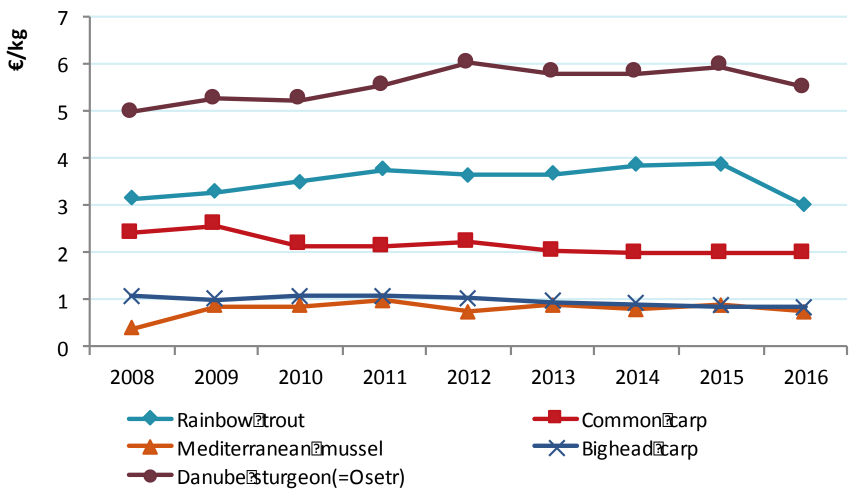


Figure 4.3.5 Average prices for the main species produced in Bulgaria: 2008-2016.
Source: EU Member States DCF data submission

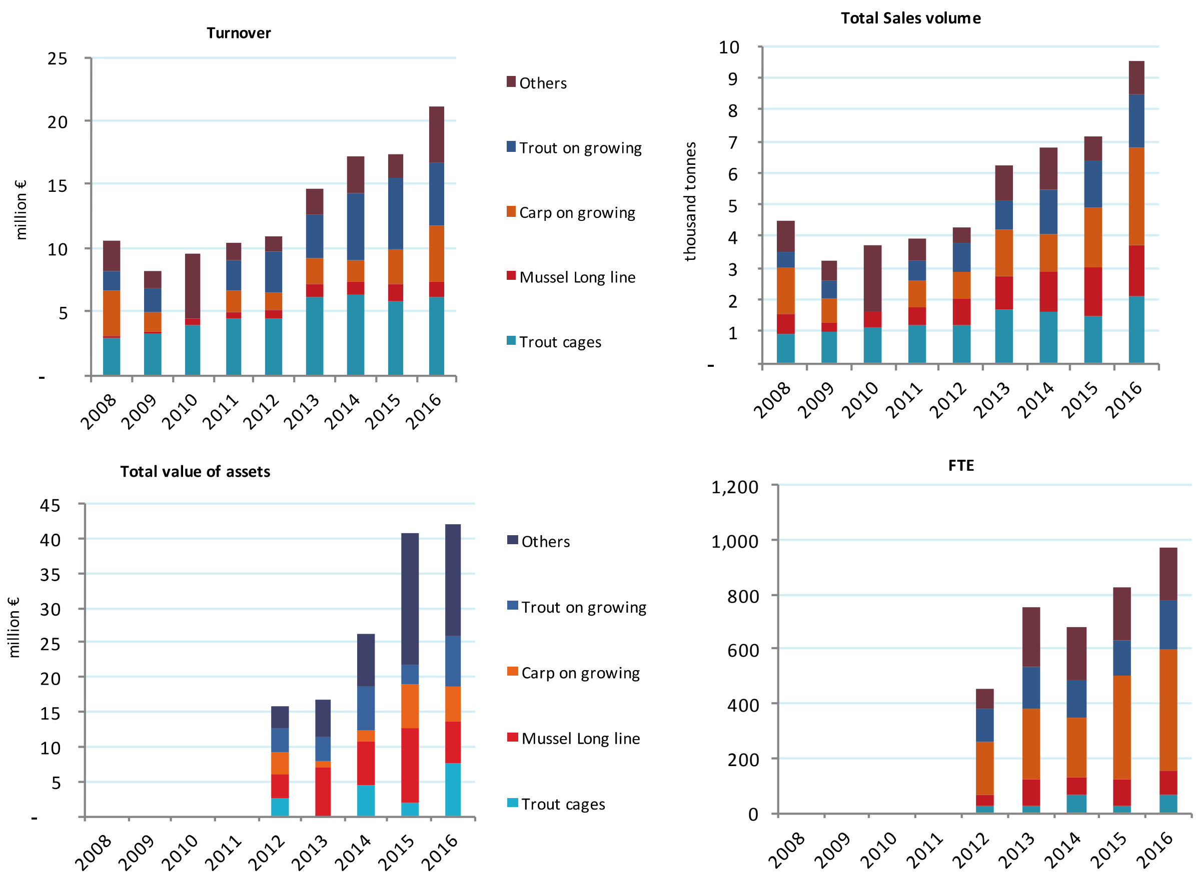


Figure 4.3.6 Structural development Bulgarian aquaculture sector: 2008-2016.
Source: EU Member States DCF data submission

Segment 1: Trout cages

The most important segment regarding the sales value and volume remained trout cages. It should be noted that the segment is composited of the same enterprises in the last 3 years. It consists of 17 active enterprises, which production was 53.7% rainbow trout and 38% brown trout. The value of total income in 2016 was €6.3 million with the amount of total sales volume 2.1 thousand tonnes. The value of the total income in 2016 increased by 7% compared to 2015, and 5% compared to the average of the period 2008-2015. Total sales volume in 2016 increased by 40% compared to 2015 and by 64% compared to the average of the period 2008-2015.

The amount of GVA generated by the trout cages segment in 2016 was €4.6 million, which is 19% less than 2015 and decreased by 15% over the period 2008-2015. The OCF in 2016 was €5 million and decreased by 10% compared to 2015 and 7% over the period 2008-2015. The amount of EBIT and Net profit in 2016 were €4.2 million for both of them and decreased by 22% compared to 2015 and both decreased by 18% and 17% respectively over the period 2008-2015.

The largest cost item of the trout cages segment in 2016 was the Raw material costs: feed costs with the 36% of all the operational costs. The consumption of fixed capital made up 30% of all operational costs and wages and salaries were the 17%.

Segment 2: Mussels long line

The segment is the only one representative of the marine aquaculture, which unites 33 enterprises which increased by 10% compared to 2015 and by 43% compared to 2014. The production from this segment is only Mediterranean mussel. The value of the total income in 2016 was €1.2 million, 99% of the income came from the sales, 1% is from other income. The amount of total sales volume was 1.6 thousand tonnes in 2016, which was 10% more that in 2015, and 98% more that the average value for 2008-2015.

In terms of economic indicators, the amount of GVA generated by the mussel long line segment in 2016 was €1.1 million and has decreased by 13% compared to 2015 and increased by 19% over the period 2008-2015. The amount of OCF in 2016 was €1 million and decreased by 22% compared to 2015 and 39% over the period 2008-2015. The amount of EBIT in 2016 was €-0.02 million increased by 98% compared to 2015 but decreased by 104% compared over the period 2008-2015. The amount of net profit in 2016 was €-0.02 million increased by 98% compared to 2015 but decreased by 105% compared over the period 2008-2015.

The largest cost item of mussel long line segment in 2016 was the consumption of fixed capital with 73%. Wages and salaries represented the 18% of all operational costs and other operational costs were the 4%.

Table 4.3.4 Economic performance of main Bulgarian aquaculture segments: 2008-2016 (in million €).

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	% of total income	Change 2016/15	Development 2016/(2008-15)
Trout cages												
Total income					*5.1*	*6.2*	*6.8*	*5.9*	*6.3*	*100%*	*7%*	*5%*
Gross Value Added					*4.1*	*5.9*	*5.8*	*5.6*	*4.6*	*73%*	*-19%*	*-15%*
Operating cash flow					*4.1*	*5.9*	*5.9*	*5.6*	*5.0*	*80%*	*-10%*	*-7%*
Earning before interest and tax					*3.8*	*5.9*	*5.4*	*5.4*	*4.2*	*67%*	*-22%*	*-18%*
Net profit					*3.6*	*5.9*	*5.4*	*5.4*	*4.2*	*67%*	*-22%*	*-17%*
Total sales volume (thousand tonnes)	*0.9*	*1.0*	*1.1*	*1.2*	*1.2*	*1.7*	*1.6*	*1.5*	*2.1*		*40%*	*64%*
Mussel Long line												
Total income					*0.9*	*2.9*	*2.4*	*1.6*	*1.2*	*100%*	*-23%*	*-38%*
Gross Value Added					*0.6*	*1.0*	*0.9*	*1.3*	*1.1*	*91%*	*-14%*	*19%*
Operating cash flow					*0.7*	*2.4*	*1.9*	*1.2*	*1.0*	*79%*	*-22%*	*-39%*
Earning before interest and tax					*0.4*	*1.9*	*0.8*	*-1.1*	*0.0*	*-2%*	*98%*	*-104%*
Net profit					*0.4*	*1.8*	*0.7*	*-1.1*	*0.0*	*-2%*	*98%*	*-105%*
Total sales volume (thousand tonnes)	*0.6*	*0.3*	*0.5*	*0.6*	*0.8*	*1.0*	*1.3*	*1.5*	*1.6*		*10%*	*98%*
Carp on growing												
Total income					*1.9*	*4.1*	*2.0*	*3.4*	*5.0*	*100%*	*46%*	*76%*
Gross Value Added					*1.1*	*1.4*	*0.7*	*1.3*	*1.1*	*21%*	*-18%*	*-7%*
Operating cash flow					*0.7*	*2.6*	*0.2*	*0.8*	*2.2*	*45%*	*190%*	*110%*
Earning before interest and tax					*0.7*	*2.5*	*0.1*	*0.5*	*1.4*	*27%*	*198%*	*44%*
Net profit					*0.7*	*2.5*	*0.0*	*0.5*	*1.4*	*28%*	*206%*	*51%*
Total sales volume (thousand tonnes)	*1.5*	*0.8*		*0.9*	*0.8*	*1.5*	*1.2*	*1.9*	*3.0*		*56%*	*149%*
Trout on growing												
Total income					*3.5*	*3.9*	*5.8*	*5.8*	*5.2*	*100%*	*-10%*	*9%*
Gross Value Added					*2.4*	*2.1*	*3.2*	*4.1*	*1.7*	*34%*	*-57%*	*-41%*
Operating cash flow					*2.3*	*2.3*	*2.9*	*3.7*	*1.3*	*24%*	*-66%*	*-55%*
Earning before interest and tax					*2.2*	*2.2*	*2.5*	*3.4*	*0.9*	*17%*	*-74%*	*-66%*
Net profit					*2.2*	*2.2*	*2.4*	*3.4*	*0.8*	*16%*	*-75%*	*-67%*
Total sales volume (thousand tonnes)	*0.5*	*0.5*	*0.7*	*0.6*	*0.9*	*0.9*	*1.4*	*1.4*	*1.7*		*17%*	*88%*

Source: EU Member States DCF data submission

Segment 3: Carp on growing

This segment is the biggest one in terms of the number of enterprises in it - 403. It represented 72% of all the active enterprises in Bulgaria and it also employed 49% of the employees in the sector. Most of the enterprises in this segment can be characterized as extensive and their production and income were negligible. The value of total income in 2016 was €5 million, which was 46% increase compared to 2015, and 76% compared to the average for 2008-2015. The amount of total sales volume was 3.0 thousand tonnes in 2016, which represented a 56% increase compared to 2015 and 149% compared to the average value for 2008-2015.

In terms of economic indicators, the amount of GVA generated by the carp on growing segment in 2016 was €1.1 million and has decreased by 18% compared to 2015 and 7% over the period 2008-2015. The amount of OCF in 2016 was €2.2 million and increased by 190% compared to 2015 and 110% over the period 2008-2015. The amount of EBIT in 2016 was €1.4 million which also increase significantly compared to 2015 and increased by 44% over the period 2008-2015. The amount of net profit in 2016 was €1.4 million increased by 206% compared to 2015 and 51% over the period 2008-2015.

The largest cost item of carp on growing segment in 2016 was the raw material costs: feed cost with the 42%. Wages and salaries represented the 18% of all operational costs and other operational costs were the 5%.

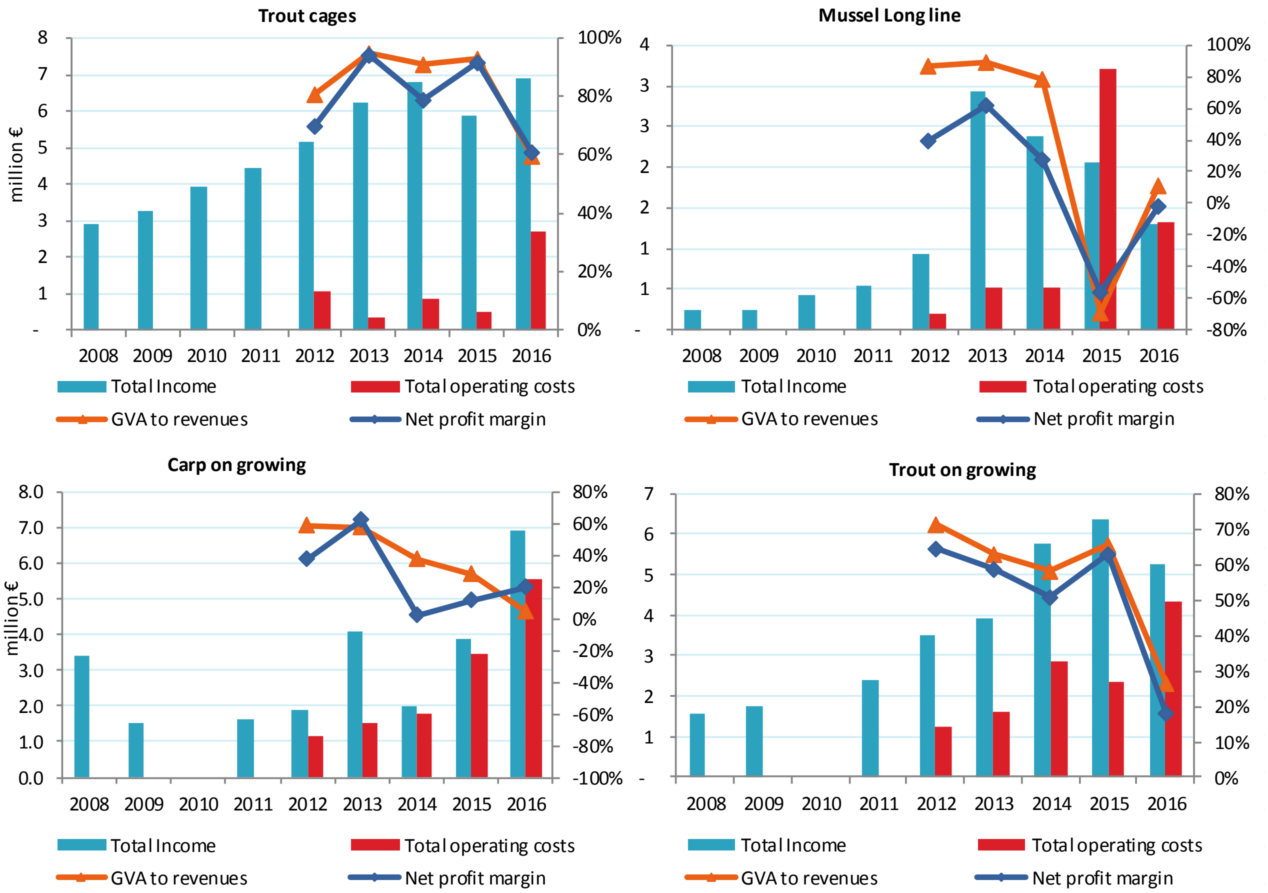


Figure 4.3.7 Economic performance indicators for the main Bulgarian segments: 2008-2016.
Source: EU Member States DCF data submission

Segment 4: Trout On growing

For the proposes of this report the segment represents two segments from DCF, which were reported separately in the previous reports: trout combined and trout on growing. Bulgaria prepared the data based on the segments from EU-MAP, where the segment was Trout ponds, since it was more appropriate for the current situation in the sector. In order to continue the time series and to have reliable data despite of the changes in the format of segments, combining historical data for both segments was the only possible solution.

This segment consisted of 74 active enterprises, 71 of which were with less than 5 employees and, as in the trout cages segment, the main produced species is rainbow trout with the 98.6% followed by the brown trout with 0.2%. The value of total income in 2016 was €5.2 million, which is 10% lower than in 2015, but 9% more compared to the average for the period 2008-2015. The amount of total sales volume in 2016 remained relatively stable with 17% increase from 1.4 thousand tonnes in 2015.

In terms of economic indicators, the amount of GVA generated by the trout on growing segment in 2016 was €1.7 million and has decreased by 57% compared to 2015 and 41% over the period 2008-2015. The amount of EBIT in 2016 was €0.9 million and decreased by 74% compared to 2015 and 66% over the period 2008-2015. The amount of net profit in 2015 was €0.8 million and decreased by 75% compared to 2015 and 67% over the period 2008-2015.

The largest cost item of trout combined segment in 2016 remained the raw material costs: feed costs with the 59% of all operational costs. Wages and salaries represented the 11% and consumption of fixed capital is 9%.

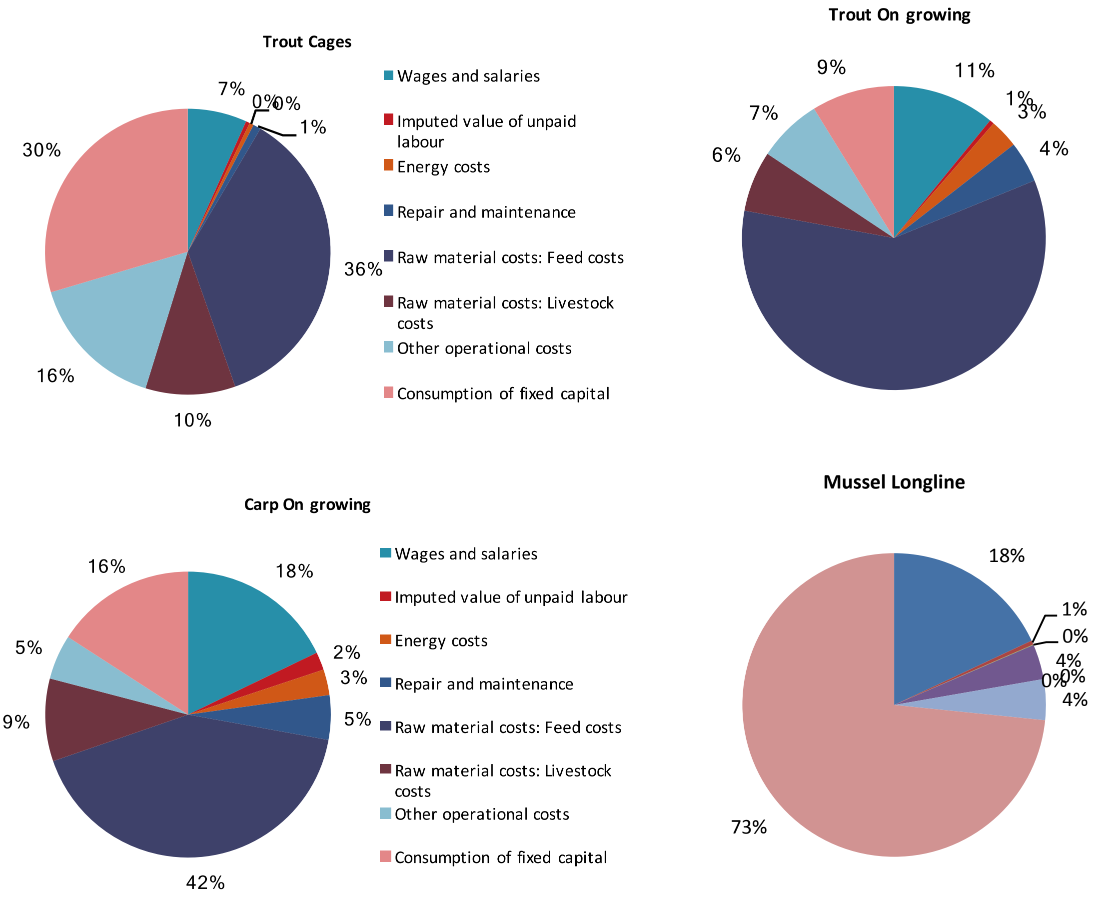


Figure 4.3.8 Cost structure of the main segments in Bulgaria: 2016.
Source: EU Member States DCF data submission

4.3.5 Trends and triggers

Current production trends and main drivers

The significant part of Bulgarian aquaculture consists of the production of rainbow trout, carp and Mediterranean mussel. The production of carp is a stable trend until 2015, due to the culture and traditions of the people. Compared to 2015 in 2016 the carp production marks growth by increase of 76% in terms of volume and 75% in terms of value. This growth may be due to the export orientation of this sub-sector of the market, mainly for Romania. The cultivation of rainbow trout and Mediterranean mussel continues to grow as the demand for these species is also growing not only for the domestic market but also for export. In the last 3 years, the segment trout cages contain 17 enterprises, which are the same during the years and they generated around one-third of total income for 2016 and net profit €4.2 million. This indicated that the segment is not only profitable and also quite sustainable compared to the other segments in the sector. In the recent years the investments were made in the construction of new and modernization of existing aquaculture enterprises. In regards to the production trends during the last five years and the increasing interest in cage farming and recirculation system farming, it gradual growth of the economically valuable species is visible. Good example is cultivation of North African catfish which in 2016 reach 14% (€2.9 million) of Bulgarian aquaculture production in terms of value which is five times increase compared to the period 2013-2015.

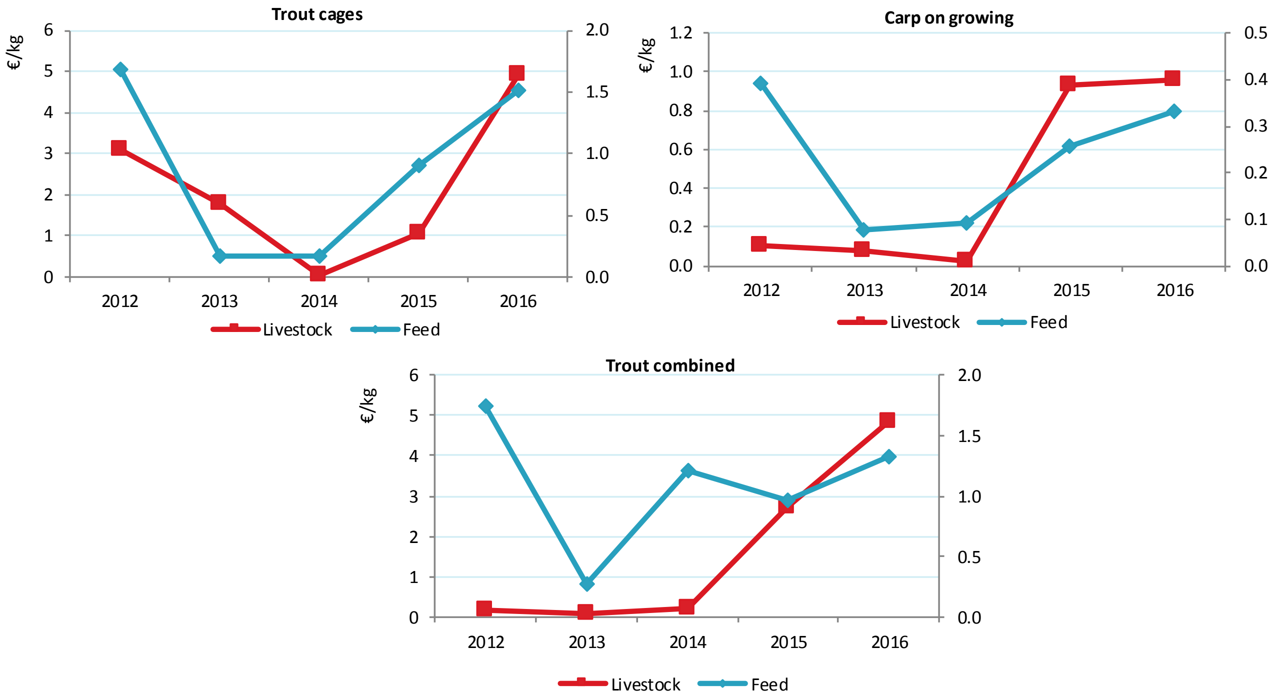


Figure 4.3.9 Feed and livestock prices for the main Bulgarian segments: 2008-2016.
Source: EU Member States DCF data submission

Market structure

The market structure in Bulgaria is still under development. There is a need for organization and construction of retail stores and wholesale distribution network of fish and fish products, including exchanges and specialized centres for purchasing fish not only near the seaside but also in the middle of the country. In some mountain and rural regions, the distribution of fresh fish is absent so that the consumption of fish in these regions is much lower than the average per capita in the country.

Some of the aquaculture enterprises own processing facilities located near the production facilities, which helps them to add the value of their products.

The main kinds of products produced for consumption are the chilled rainbow trout, the life species from the carp family from the freshwater, and frozen Mediterranean mussel from the marine species. The production is increasing in terms of volume and value year by year due to stable demand on the domestic market and increased export of processed products with added value and their good market price.

The whole aquaculture sector is characterized by many small producers at primary level, enterprises with less than 5 employees are more than 90% of all aquaculture farms. The structure of the market has improved over the past few years but there is still a need for a better organization to function better and to compete with other markets in the region.

The production of sturgeon species still is not significant both in volume and value. The sector producing less than 200 tonnes which can be explained by the fact that the main purpose of growing these species is reaching of sexual maturity and the production of caviar, which takes a significant amount of time.

The Bulgarian market is still developing and the facilities for fish and fish products are not very well organized. A big quantity of fish and fish products are imported every year by the supermarket chains and the prices are generally lower than the offered by the local producers.

Issues of special interest

Despite the increasing interest in cage farming and recirculation system farming, only a few enterprises take the initiative to produce new species like an eel, coho salmon and African catfish. For now, the result is visible only with African catfish were the reaching of market size is quite short. The object of special interest remains the farming of rainbow trout and Mediterranean mussel.

Outlook for future

The diversified production of species with high market price, as well as organic produce based on the traditional extensive technologies could be used for the increase of the aquaculture production. Another possibility to unleash the potential of the sector is by the adding of value to own production by processing and export.

This goal from the Bulgarian national strategy on aquaculture seems achievable by the introduction of innovations, the development of market chains and by producing of species with high foreign market value or significantly improved products.

Improving the competitiveness of the enterprises can be achieved also by the general modernization of the enterprises, improving their resource efficiency and fulfilling the measures to protect waters and their conversion to intensive or super-intensive innovative technologies.

In accordance with the multiannual national strategic plan for aquaculture (2014-2020) the aquaculture development will be supported primarily through investment in the expansion and modernization of existing farms and diversification of the production of new species, and activities will be supported related to the improvement of production efficiency - adding value to production, utilization of waste, improving the working conditions, including protection against loss of production from predators and poachers. Support is needed also for the development of technical innovations and knowledge in the field of aquaculture and processing of aquaculture products and the opportunity to ensure aquaculture stock in order to prevent losses from natural disasters.

In terms of challenges to the fish and fish products market, it is necessary to encourage and support the establishment of producer organizations in fisheries and aquaculture, which then should be able to improve the management of their activities, increase their sells and raise the demand for their products. In regard to this, the development production and marketing plans will be supported. The successful operation of the producer organisations depends on the existence of complete market information and the possibility of carrying out joint promotional or advertising campaigns on the Bulgarian market.

According to the analysed period, we can expect better future for the Bulgarian aquaculture sector. The reason is that the Bulgarian aquaculture sector opportunities are at a higher level, making a historical analysis on production volume and value. In terms of expansion and modernization of existing farms and diversification of the production of new species is expected FTE to stay stable or to increase. Also, these measures are expected to affect positively on the competitiveness of the sector. By the applying of environmental measures and subsidies for new farms for organic production is expected to reduce the impact of aquaculture on the environment.

The most of the expected results seem to be reachable and realistic because by subsidizing the construction of new enterprises the level of production should grow and the number of total employees should also increase.

4.3.6 Data Coverage and Data Quality

Data quality

Achieved sample rate for economic data for 2016 was 100%, as in 2014 and 2015. This achieved sample rate has an impact on the quality of the data provided by the industry, which also understood the importance of data provision.

Data availability

Data for the aquaculture sector is published once a year. The aquaculture statistic is published on Agricultural Report and on the website of the Executive agency for fisheries and aquaculture approximately 12 months after the end of the reference year.

Confidentiality

In 2016, there were no confidentiality issues and in 2015 there was only one segment with one enterprise, and data for it will not be published. In the other segments number of enterprises is more than five and data are available.

All segments are divided by the species and technique. If an enterprise produces more than one species, then it is allocated to the segment of the species that represents the biggest volume of sales.

Some enterprises own more than one farm using different techniques, but these activities are grouped together because the company is used as data collection unit. There are very few examples of enterprises using more than one production technique.

Differences in DCF data compared with other official data sources

The main reason for the discrepancy between the DCF data, FAO and Eurostat is that the DCF data includes only the sales that the owner of every company had declared by the annual questionnaire. The data that the national authorities provides to Eurostat regarding the produced fish includes the quantity of unsold fish and the quantity of fish which have not reached consumptive size yet.

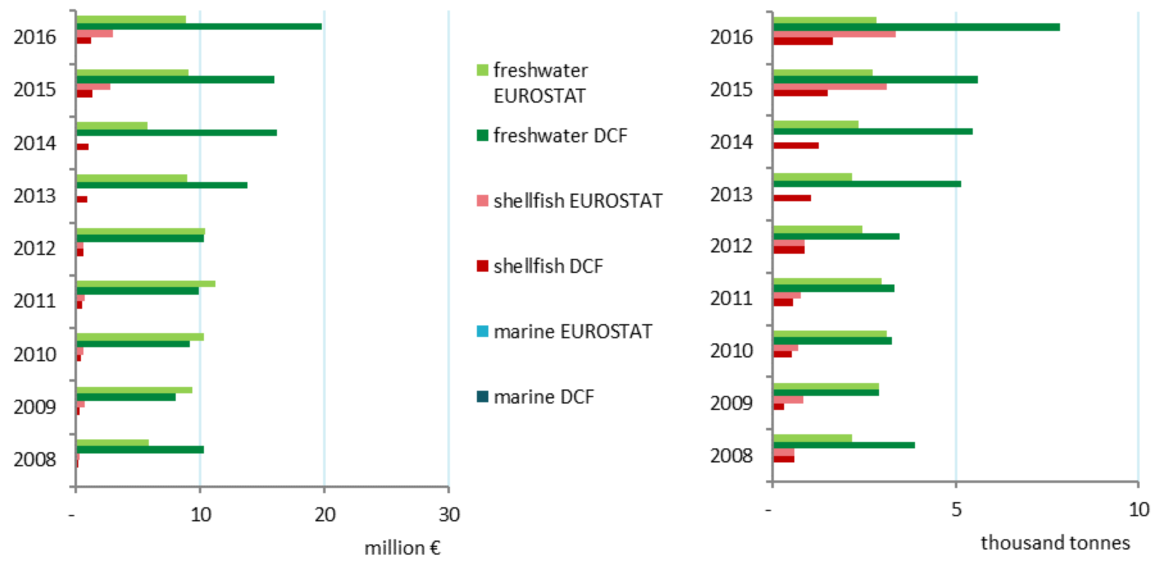


Figure 4.3.10 Comparison of DCF data with EUROSTAT data for Bulgaria: 2008-2016

4.4 Croatia

4.4.1 Production and sales

Croatian marine aquaculture recorded a significant increase in 2016, where is noted a 5.7% increase in sales volumes compared to the previous year, also in the context of sales values. The most important species, in this context, are European sea bass (*Dicentrarchus labrax*), Gilthead sea bream (*Sparus aurata*) and Atlantic Bluefin tuna (*Tunnus thynnus*) of fish species and Mediterranean mussel (*Mytilus galoprovincialis*) and European flat oyster (*Ostrea edulis*) of shellfish species. Production and sales in marine aquaculture in total follows the objectives of the National Strategic Plan for Aquaculture 2014-2020.

The most important species in freshwater farming are common carp (*Cyprinus carpio*) and rainbow trout (*Oncorhynchus mykiss*). Unlike marine aquaculture, production and sales in freshwater aquaculture is falling behind the objectives of the National Strategic Plan for Aquaculture 2014-2020. Still, concerning funds allocated for aquaculture and recent changes in diversity of production, it could be expected that production in this segment will be back on the track until the end of operational period (2023).

Table 4.4.1 Production and sales for Croatia: 2012-2016.

Variable	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/ (12-15)
Sales weight (thousand tonnes)	***13.6***	***13.0***	***13.8***	***16.9***	***17.3***	*2%*	*21%*
Marine	7.5	8.6	9.3	11.4	12.5	*10%*	*36%*
Shellfish	1.3	0.7	0.7	0.7	0.7	*8%*	*-13%*
Freshwater	4.8	3.7	3.8	4.8	4.0	*-17%*	*-6%*
Hatcheries & nurseries	0.0	0.0	0.0	0.0	0.0		
Sales value (million €)	***77.7***	***80.9***	***77.5***	***102.7***	***108.6***	*6%*	*28%*
Marine	68.4	71.7	69.5	93.2	99.3	*7%*	*31%*
Shellfish	1.6	0.9	1.0	1.2	1.4	*15%*	*18%*
Freshwater	7.7	8.1	6.9	8.3	7.9	*-5%*	*1%*
Hatcheries & nurseries	0.0	0.1	0.0	0.0	0.0		*33%*

Source: EU Member States DCF data submission

In total, the period 2012-2016 shows steady growth in terms of sales volume and sales values. Therefore, 2016 has 2.3% more sales weight than in previous year. Also sales value has slightly increased during the same period, with €108.6 million.

4.4.2 Industry structure and employment

Majority of Croatian total number of enterprises are small family owned shellfish farms. However, in terms of sales volume and value, they are insignificant. As it is shown in the table below, the largest part of the enterprises belongs to the segment with 5 or less employees. Although number of aquaculture companies stayed steady in the last time series, there were some changes in structure of companies. Unlike in the previous time series, the number of enterprises with more than 10 employees is slightly declining: in 2015 there were 22 and in 2016 20. At the same time, number of companies with less than 5 employees increased and total number of employees is also increasing.

Apart from previous time series, average wage become balanced with steady growth, so as labour productivity. Stabilization could be direct consequence of market stabilization with more persons employed permanently and less involved in seasonal work. In general, indicators on the industry structure and employment show increasing trends. Also, during past two years, a value of unpaid labour stabilised with slight increase, which is directly connected with better reporting from family owned small scale companies.

Table 4.4.2 Structure of the Croatian aquaculture sector: 2012-2016.

Variable	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/(12-15)
Structure (number)							
Total enterprises	*174*	*169*	*179*	*187*	*187*	*0%*	*6%*
<=5 employees	137	132	139	144	150	*4%*	*9%*
6-10 employees	20	18	19	21	17	*-19%*	*-13%*
>10 employees	17	19	21	22	20	*-9%*	*1%*
Employment (number)							
Total employees	*1,882*	*1,786*	*2,371*	*2,197*	*2,196*	*0%*	*7%*
Male employees	1,497	1,415	2,053	1,606	1,603	*0%*	*-2%*
Female employees	385	371	318	591	593	*0%*	*42%*
FTE	1,451	1,505	1,585	1,624	1,647	*1%*	*7%*
Male FTE	1,167	1,214	1,373	1,271	1,313	*3%*	*5%*
Female FTE	284	290	212	353	334	*-5%*	*17%*
Indicators							
FTE per enterprise	8.3	8.9	8.9	8.7	8.8	*1%*	*1%*
Average wage (thousand €)	17.7	12.6	15.7	12.5	13.5	*8%*	*-8%*
Labour productivity (thousand €)	12.1	10.0	-12.3	31.8	30.0	*-6%*	*189%*

Source: EU Member States DCF data submission

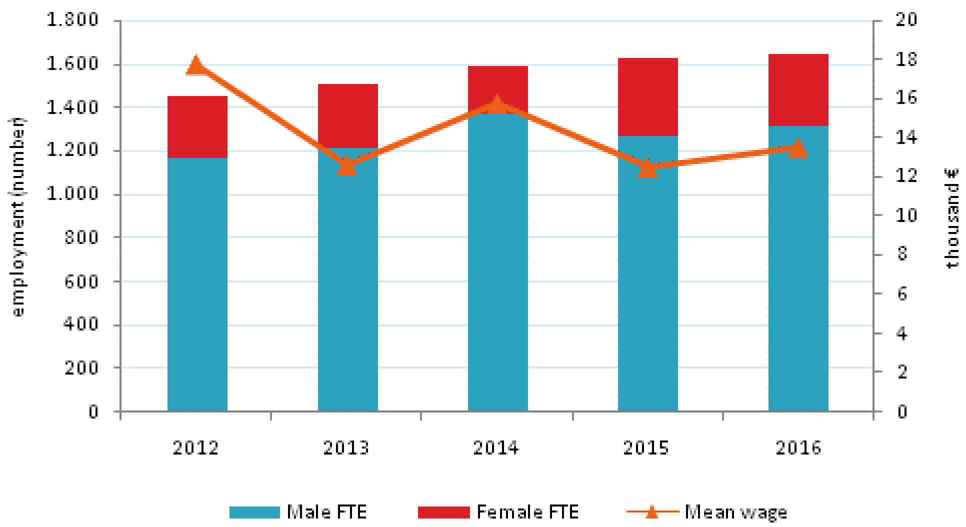


Figure 4.4.1 Employment trends for Croatia: 2012-2016.
Source: EU Member States DCF data submission

The total number of persons employed in the Croatian aquaculture sector in 2016 was 2 196, corresponding to 1 647 FTEs. The number of employees have variations primarily because lot of workers in aquaculture have temporary job, some of them are working as seasonal employees, part of employees with full time job are working partly in aquaculture and partially in other activities in the same enterprise. Apart from previous time series, average wage stayed stable with steady growth, and enterprises managed to raise the labour productivity. Stabilization could be direct consequence of market stabilization with more persons employed permanently and less involved in seasonal work during 2015 and 2016. On the other hand, a strong trend of diversification – including processing industry and fisheries in marine aquaculture and other agricultural activities in freshwater aquaculture, variations in number of employees could be expected. Following the expectations from the previous report, number of female workers slightly increased so the ratio between male and female employees is more balanced.

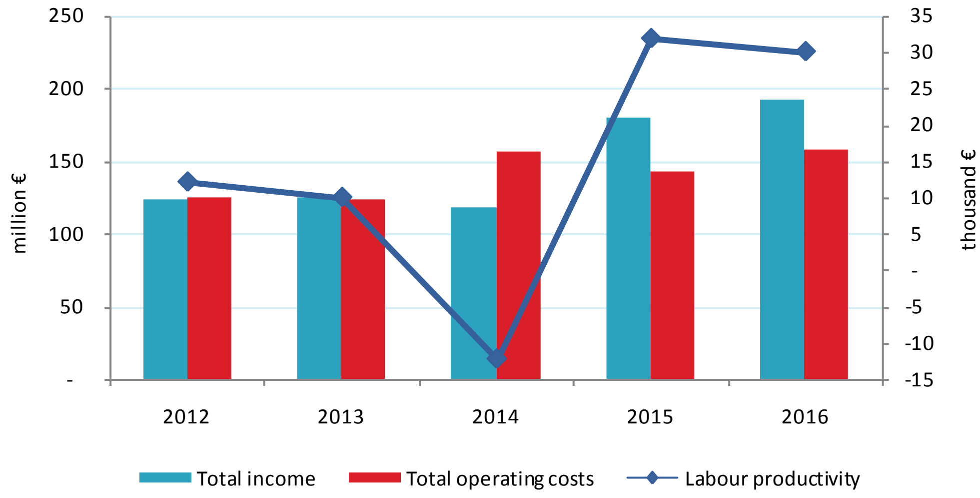


Figure 4.4.2 Income, costs, wages and labour productivity trends for Croatia: 2012-2016.
Source: EU Member States DCF data submission

4.4.3 Economic performance

After the general financial crisis has again been an inevitable negative impact and in the coming years caused significant damage, in 2015 and 2016 there are visible signs of recovery. According to financial reports of tuna farming companies, in 2013 and partially in 2014, in a segment with the largest share of value, other marine fish cages, damage was caused in 2013 when the unfavourable trend of the Japanese yen to the Croatian kuna exchange rate was significant, both to the finally determined operating result (participating in financial expenses) but also in terms of liquidity, which was partly amortized by previous borrowing in the JPY currency or in the currency of the commercial inflow. Negative impact of misbalance between currencies could be seen in financial costs for 2013. Nevertheless, from 2012 to 2016 total income increased from €123.3 million to €192.5 million.

After continuous growth in investment until 2014, net investments are in trend of decreasing, while there has been a continuous growth in debt from 2012-2016.

Increasing revenue is leading to growth of expenses. On the opposite, after very high expenses in 2014, expenses in general decreased in 2015 and returned to a track in 2016. Other operational costs shared larger share in costs from 2015, when investments from previous years have been realized and enabled diversification of activities, which is visible in strong increase of other income. From 2015, some companies have also turned to larger production, the purchase and development of existing generating units, which could lead to better results in the coming years.

Total revenue fell from €123.3 million in 2012 to €113.8 million in 2014 and grew to €192.5 million in 2016. Turning back to previous time series, certain costs have increased as a result of a weak performance in general which leads to bad indicators, from net profit to return on investment. However, extraordinary costs, repairs and maintenance costs along with other operational costs in 2014 partly are the result of catastrophic floods which is made damage to some number of companies.

The largest share of expenditures are operational costs (33%), then cost of feed (28%) and cost of wages and salaries (11%). The expenditures on feed have increased by 16% and expenditures on livestock have decreased by 18%, which follows growth in production from 2015 to 2016.

Expenditures on wages and salaries have increased by 7% compared to 2015. The total expenditures make up for 82% of the total income.

Table 4.4.3 Economic performance of the CroatianBulgarian aquaculture sector: 2012-2016.

Variable	2012	2013	2014	2015	2016	% of total income	Change 2016-15	Development 2016/(2012-15)
Income (million €)								
Turnover	77.7	80.9	77.5	102.7	108.6	*56%*	*6%*	*28%*
Other income	38.7	39.5	35.2	71.6	76.2	*40%*	*6%*	*65%*
Subsidies	6.9	4.6	5.1	5.4	7.7	*4%*	*42%*	*40%*
Total income	*123.3*	*125.0*	*117.8*	*179.7*	*192.5*	*100%*	*7%*	*41%*
Expenditures (million €)								
Wages and salaries	25.7	18.9	24.8	20.1	22.0	*11%*	*9%*	*-2%*
Imputed value of unpaid labour	0.0	0.1	0.2	0.2	0.3	*0%*	*19%*	*108%*
Energy costs	6.6	5.6	5.7	2.5	3.0	*2%*	*22%*	*-41%*
Repair and maintenance	2.5	2.5	3.5	2.4	3.3	*2%*	*34%*	*20%*
Raw material: Feed costs	41.3	36.5	62.5	46.0	53.2	*28%*	*16%*	*14%*
Raw material: Livestock costs	6.7	9.5	16.0	11.1	13.1	*7%*	*18%*	*21%*
Other operational costs	41.7	51.3	44.4	60.6	62.7	*33%*	*3%*	*27%*
Total operating costs	*124.6*	*124.3*	*157.1*	*142.9*	*157.6*	*82%*	*10%*	*15%*
Capital Costs (million €)								
Depreciation of capital	8.4	7.9	11.4	9.4	12.6	*7%*	*34%*	*35%*
Financial costs, net	5.0	14.7	4.8	2.3	3.0	*2%*	*28%*	*-55%*
Extraordinary costs, net	-1.3	-0.1	0.3	0.4	-0.6	*0%*	*-266%*	*-225%*
Capital Value (million €)								
Total value of assets	309.4	312.3	418.1	387.8	274.9	*143%*	*-29%*	*-23%*
Net Investments	20.0	33.9	36.9	29.2	21.2	*11%*	*-27%*	*-29%*
Debt	119.8	119.5	157.4	174.7	238.1	*124%*	*36%*	*67%*
Input & Production (thousand tonnes)								
Raw material: Feed	62.8	64.3	83.5	66.9	73.0		*9%*	*5%*
Raw material: Livestock	2.3	2.5	1.5	3.6	2.5		*-30%*	*1%*
Performance Indicators(million €)								
Gross Value Added	17.5	15.0	-19.5	51.7	49.5	*26%*	*-4%*	*205%*
Operating cash flow	-1.2	0.7	-39.3	36.8	34.9	*18%*	*-5%*	*4587%*
Earning before interest and tax	-9.7	-7.3	-50.7	27.4	22.4	*12%*	*-18%*	*322%*
Net profit	-14.7	-22.0	-55.5	25.1	19.4	*10%*	*-23%*	*215%*
Capital productivity (%)	5.7	4.8	-4.7	13.3	18.0		*35%*	*276%*
Return on Investment (%)	-3.1	-2.3	-12.1	7.1	8.1		*15%*	*409%*
Future Expectation Indicator (%)	3.7	8.3	6.1	5.1	3.1		*-39%*	*-46%*

Source: EU Member States DCF data submission

After two years of negative trend in all the performance indicators and turbulent 2014, during 2015 and 2016 most if the indicators significantly improved. The contribution of the sector to the economy was €49.5 million, which accounts for 26% of total income. Relatively high contribution of other income (31% in 2012, 40% in 2016) could be a sign of diversification of economic activities, especially for large aquaculture companies, often involved in other types of production beside aquaculture, like agriculture, fishing or fish processing. Some of these activities were financed through subsidies, through specific lines promoting processing and marketing of seafood products in the context of EFF. From 2013 to 2016 subsidies share of subsidies arose from 4.6% to 7.7%. Besides promoting processing and marketing of seafood products, a significant part accounted for investments in aquaculture. On the other hand, in case of some of the companies from freshwater aquaculture, investments in other agricultural activities completely took over fish production.

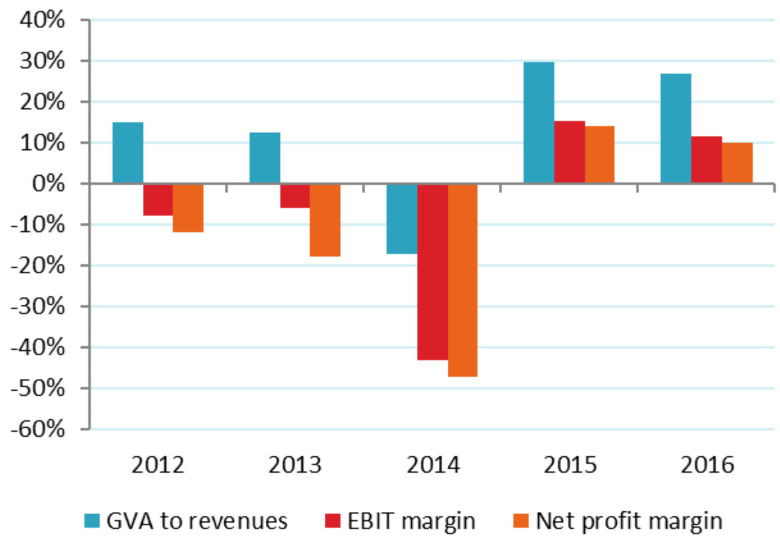


Figure 4.4.3 Economic performance for Croatia: 2012-2016
Source: EU Member States DCF data submission

From 2012-2014 economic indicators showed low performance. However, indicators during 2015 and 2016 showed significant improvement. The EBIT margin and Net profit margin increased in 2015 because of the increasing total income and decreasing total costs. After 2015, GVA for the sector decreased as a result of higher total costs.

The gross value added for the sector as a whole decreased by 4% from 2015 and 2016 and both EBIT and net profit were positive, but lower than 2015. The total value of assets decreased by 29% and debts increased by 36%. The net investment decreased 27% and is now 29% under the average from 2008 to 2015.

4.4.4 Main species produced and economic performance by segment

The most important individual species in Croatian aquaculture is Bluefin tuna, covering the 34% of the total value. There were only 4 tuna farms in Croatia, and they are exporting all of their products to Japan. Since tuna farming is based on catching wild juveniles, and it is under the strict ICCAT surveillance, further increase of production is relying on the available quota.

The second most important species is seabass, which is most often farmed in combination with sea bream. Most farms are located on the middle part of coast, on the Zadar area. Around 70% of seabass production has been exported on the EU market, and the rest is sold on the local market. Before Croatia joined the EU export was restricted by quotas. For that reason, as expected, there was an increase in production and export during last two years.

In 2014, total production of oysters and mussels was sold on the national market due to export restrictions for the non EU members. From 2013, the EU market has been open for Croatian producers since Croatia became member of EU. Almost all shellfish farms are producing both oysters and mussels, but dominated by mussels in value and weight. It is expected that shellfish production will increase in the next years.

The freshwater aquaculture production is mostly sold at the national market, and only a small fraction is exported to the EU market. Main species in freshwater aquaculture is carp with 16% of total weight. All carp farms are located in inland part of Croatia, and most of enterprises have its own production of eggs and larva with combined production. Second most common species is trout. Beside carp and trout most farms are growing some other freshwater species, like grass carp, bighead carp, silver carp, wels catfish, pike and zander, but in smaller quantities.

Figure 4.4.4. Main species in terms of weight and value in Croatian aquaculture production: 2016.
Source: EU Member States DCF data submission

The importance of Atlantic blue fin tuna in terms of total value of aquaculture production could be seen from Figure 4.4.4. But it should be mention that Atlantic blue fin tuna sector depends on the world market and the price can vary significantly between years. In terms of value it is followed by the sea bass and sea bream. These three species represent more than 90% of total Croatian aquaculture production in value, arriving to the 95% when considering also common carp.

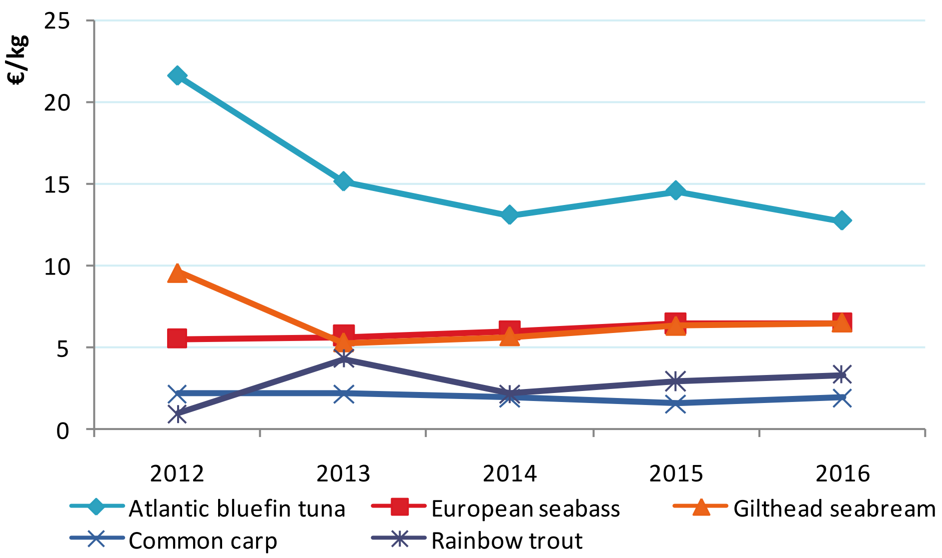


Figure 4.4.5 Average prices for the main species produced in Croatia: 2012-2016.
Source: EU Member States DCF data submission

Average prices for all species stayed at the same level between 2015 and 2016, a slight decrease of 13% had Bluefin tuna from 2015 to 2016. From 2015 to 2016 Sea bass stayed stable, Sea bream increased average price for 3.3% while freshwater species increased, Carp for 22.3% and Rainbow trout for 13.41%. Although prices in general increased from 2015, In Croatia, the aquaculture production has been divided into 10 segments in 2013, and 9 segments in 2014 based on the species produced and the technique used. Regarding the new EUMAP segmentation and recent trends in aquaculture, the number of segments has been decreased to 5. Due to low activity of companies previously segmented in segments of hatcheries and nurseries (Carp, Trout) those segments have been removed and data from segment of Sea bass and Sea bream hatcheries and nurseries was not shown due to the confidentiality.

There is only a few dominate species in Croatian aquaculture; Carp and Trout in freshwater; Blue fin tuna, Seabass and Seabream in marine aquaculture; mussel and oysters in shellfish production. In terms of volume the most important are seabass (31%), seabream (24%) and tuna (17%). Seabass is in general grown in combination with seabream and they are represented in 2 segments. First is cage on "hatcheries & nurseries" and second is "cages". The segment "hatcheries & nurseries" consists of one company and the others belong to "cages" segments. Due to decline of activity and predominant technique of farming, companies from "combined" segment were aggregated in segment of "cages".

The most relevant segments in the Croatian aquaculture are analysed below.

Segment 1: Seabass and seabream cages

This is the segment with the largest production, which covers 53% of total sales volume in 2016. All of these farms are growing both sea bass and sea bream, with a small quantity of other marine finfish species. It is remarkable, that this segment has more than a half of the value of the total value of assets - with 59%.

An increase in production has been noted between 2015 and 2016 in terms of weight and value for this segment and the same trend is expected in the following years. A significant increase in production of other marine fish species in this segment should also be noticed. This segment consists of 22 enterprises, which produces 9 098 tonnes of fish.

In general, enterprises in this sea bass and sea bream segment do not have production of eggs and larvae; therefore, they are buying juveniles partly from other Croatian hatcheries and partly importing from other EU countries. On the other hand, largest companies started their own production in recent years what consequently decreased the livestock costs.

Segment 2: Other marine fish cages: Bluefin tuna

The most important segment in terms of value is tuna farming; however, it is not the largest segment measured in terms of quantity. Beside value it is also important to point out that large part of small pelagic fishery is directly related to tuna farming, since tuna can be fed only with the small pelagic fish. The fact that all tuna production is being exported, gives additional importance to this segment. Limiting factor is the fact that this kind of production is based on the catch of wild juvenile tuna, and it is under the strict ICCAT surveillance and restricted by quota. In Croatia there is large potential and interest for this production and it can be expected further growth of this sector in case ICCAT increase quota for Bluefin tuna fishing.

In 2016, there were 4 active tuna farms, and they had a production of 2 934 tonnes with a value of more than €37 million. The production value of this segment corresponds to 20% of the total Croatian aquaculture production.

Seabass and seabream combined

Since this segment has suffered a decrease in terms of FTE, turnover, total value of assets, as well as other indicators, and seabass and seabream are still predominant species in their production, all enterprises were aggregated to "cages" segment.

Segment 3: Carp combined

Similar as for Sea bass and sea bream segments, due to the recent changes in EUMAP segmentation and dominant farming techniques used at carp farms, but also due to stagnation in carp production, all companies with predominant production of carp were aggregated into a segment Carp combined from 2015 which could explain some inconsistencies in time series. In total, about 78% of production in the segment accounts for carp. Still, from 2015 and 2106, volume of carp production, so as value, declined from 3 401 tonnes to 2 697 tonnes. On the other hand, production of the other freshwater fishes grew by 16% from 2015 to 2016 in volume and 18% in value. Although carp production in Croatia has over a 120 years tradition, currently is in a phase of stagnation. On the other hand, other inputs from the industry envisage the signs of technological recovery. Technological procedure of fish farming for recently renovated carp farms encompasses whole system of farming – from spawn and juveniles of all farming categories to market size commercial fish. According to National plan, results of diversification should be even more visible in the next reporting period in terms of production volume and value and involving some new species in farming cycle.

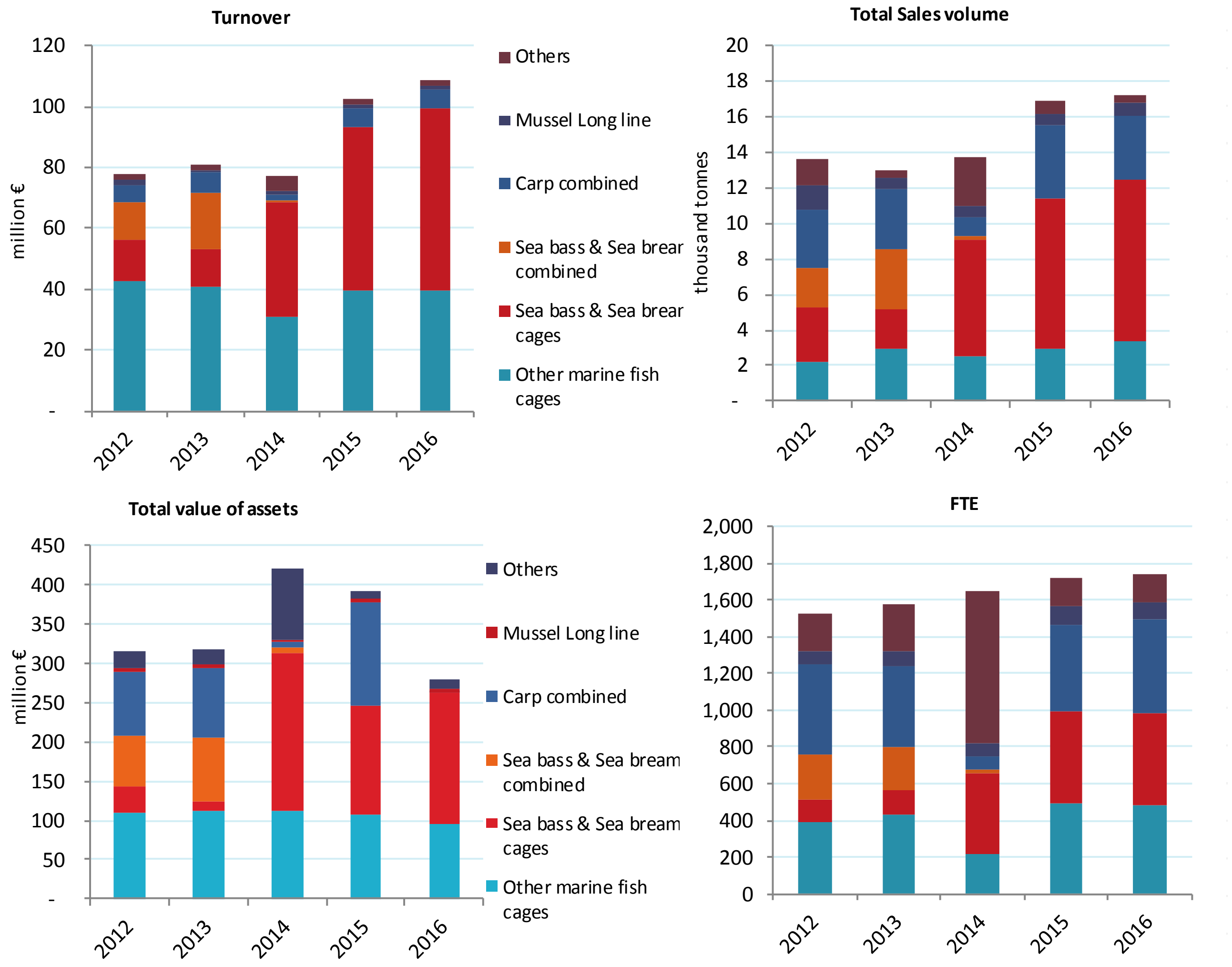


Figure 4.4.6 Structural development Croatian aquaculture sector: 2012-2016.
Source: EU Member States DCF data submission

Segment 4: Mussels long line

Although the mussel long line segment represents only 4% of the total weight, and less than 1% of the value, it is an important segment in terms of number of enterprises and employees. The segment contains 112 enterprises, but since almost all of these enterprises are small scale family businesses, it can be assumed that more people are involved and dependent on this segment production. It has to be taken into account that most of these farmers carry aquaculture as an additional activity; they are often retired or have other income apart from mussel farm enterprise. Nevertheless, total income has been increasing steadily from 2012-2016.

Table 4.4.4 Economic performance of main Croatian aquaculture segments: 2012-2016 (in million €).

Variable	2012	2013	2014	2015	2016	% of total income	Change 2016/15	Development 2016/(2012-15)
Other marine fish cages								
Total income	52.7	52.4	40.2	52.6	53.3	100%	1%	8%
Gross Value Added	22.3	24.7	10.4	25.5	22.0	41%	-14%	6%
Operating cash flow	16.7	18.8	3.5	19.2	16.3	31%	-15%	12%
Earning before interest and tax	14.2	16.8	0.7	16.3	13.0	24%	-20%	8%
Net profit	11.8	7.3	-2.7	15.4	11.7	22%	-24%	47%
Total sales volume (thousand tonnes)	2.2	2.9	2.5	2.9	3.4		16%	29%
Sea bass & Sea bream cages								
Total income	22.5	20.7	41.0	71.5	83.8	100%	17%	115%
Gross Value Added	5.4	11.9	-39.5	14.0	13.7	16%	-2%	766%
Operating cash flow	4.8	11.3	-47.1	9.1	7.8	9%	-14%	244%
Earning before interest and tax	4.0	10.7	-52.3	5.0	2.4	3%	-52%	130%
Net profit	3.2	10.6	-52.5	5.6	1.7	2%	-70%	120%
Total sales volume (thousand tonnes)	3.0	2.2	6.6	8.4	9.1		8%	80%
Carp combined								
Total income	18.5	16.2	2.7	46.7	47.4	100%	2%	126%
Gross Value Added	5.3	3.8	0.0	7.6	11.3	24%	48%	170%
Operating cash flow	1.7	0.1	-0.6	4.7	8.8	18%	85%	485%
Earning before interest and tax	-0.7	-2.4	-1.3	2.8	5.3	11%	87%	1498%
Net profit	-3.3	-5.0	0.5	0.8	3.9	8%	375%	324%
Total sales volume (thousand tonnes)	3.3	3.4	1.1	4.2	3.6		-14%	20%
Mussel Long line								
Total income	2.9	2.6	3.0	4.0	5.2	100%	30%	67%
Gross Value Added	1.6	1.3	1.3	1.6	1.6	31%	6%	12%
Operating cash flow	1.0	0.9	0.6	0.7	1.3	24%	69%	61%
Earning before interest and tax	0.5	0.5	0.1	0.4	0.9	18%	115%	138%
Net profit	0.6	0.6	0.1	0.4	0.8	16%	106%	95%
Total sales volume (thousand tonnes)	1.3	0.7	0.7	0.6	0.7		11%	-14%
Trout combined								
Total income	2.2	1.8	1.1	4.7	2.6	5%	-45%	5%
Gross Value Added	-2.4	0.3	0.5	3.0	0.8	2%	-74%	136%
Operating cash flow	-2.9	0.1	0.2	3.0	0.7	2%	-75%	629%
Earning before interest and tax	-3.2	-0.1	0.1	2.9	0.7	1%	-77%	1291%
Net profit	-3.3	-0.2	0.1	3.0	1.1	2%	-64%	1024%
Total sales volume (thousand tonnes)	1.3	0.2	0.3	0.7	0.5		-31%	-25%

Source: EU Member States DCF data submission

Almost all enterprises in segment are producing mussels and oysters, but about 93% of sales volume and 62% of sales value comes from mussel production. The production is based on the collecting of shellfish in early stages from the nature, but some of the producers are buying additional juvenile shellfish from other farms in order to increase production. Volumes in this segment are probably underreported taking into account family character of enterprises. Also, indicators related to mussel farms are dependent on few larger companies which increased their investments and business in general in past two years. Following the Croatian accession to the EU, it was expected for shellfish export to the EU market to increase since restrictions have been. However, decrease of mussel production in general, so as decrease of export to insignificant volume did not approve the expectations yet. Due to investments during 2014 and 2015, some improvements could be expected in terms of production volume and production value. Due the significance of oysters in terms of tradition and possible organic production, so as following the National Plan, additional segment has been added for oysters. In 2015 and 2016 there were only 5 farms with predominant oyster production, carrying on the family tradition. Added value of product, so as protected designations of origin and possibility of organic production with available financial instruments makes this segment valuable for next reporting period.

The economic performance analysis shows that total income has been increasing for the segment Mussel long line during last years (with a rise of 67% in total and 30% from 2015 to 2016) and other indicators are showing low, but balanced values. Since some of the farmers also farm smaller volume of finfish (sea bass and sea bream) and oysters, increase in total volume of segment did not correspond to total mussel production, decreased from 2015 to 2016.

In Figure 4.3.7, total operating costs increased from 2015 to 2016 for Sea bass and Sea bream segment, stayed balanced in segment "Other marine fish cages", increased for Mussel long line segment and significantly changed for Carp combined segment, which is about to be explained in further paragraph.

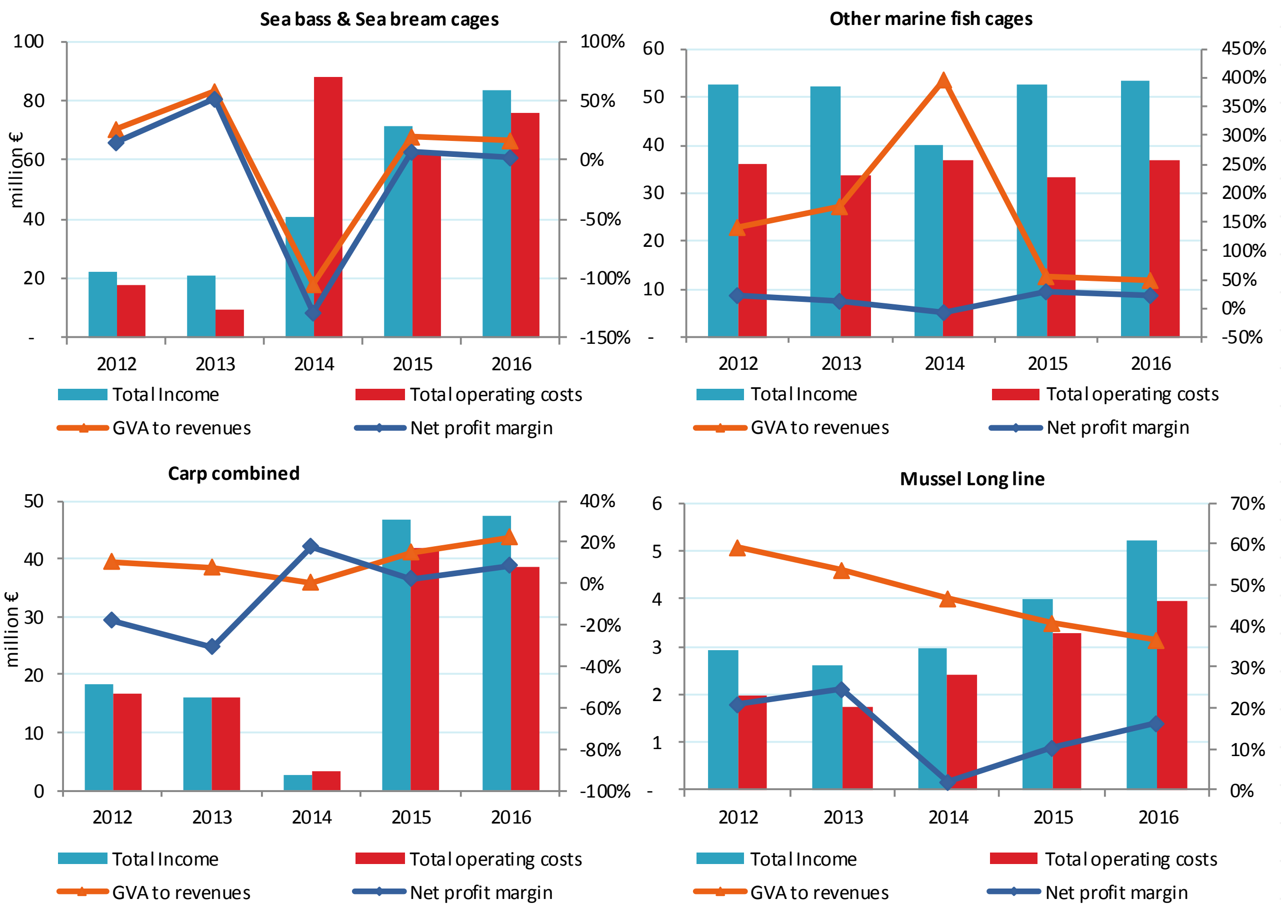


Figure 4.4.7 Economic performance indicators for the main Croatian segments: 2012-2016.
Source: EU Member States DCF data submission

Segment 1: Mussel long line

Period from 2015 to 2016 stayed stable with higher total income than total operating costs and growth of both indicators. Large part in costs structure refers to other operational costs (49%) together with wages and salaries costs (22%). Diversification has been present in this segment for past two years, which also recognizable in increase of other income, but also in livestock costs and feed costs, since some companies' large mussels production compared to finfish production which moved them to another segment, or started finfish production which caused the appearance of livestock and feed costs.

Segment 2: Carp combined

Other operational costs with 72% in total costs structure could be explained by many other activities which enterprises in this segment have and have developed during the last time series. Also high percentage of other operational costs, and smaller cost of feed, are result of company's activity in agriculture production for fish feed. Some of the largest companies have their own feed production, along with other agriculture activities. With decreasing of total income do not follow the same decrease of total operating costs. because of the new segmentation. Furthermore, according to new trends of technology improvements and diversification of production, all companies producing carp were aggregated in the segment Carp combined, making the previous time series incomparable with the period of 2015-2016.

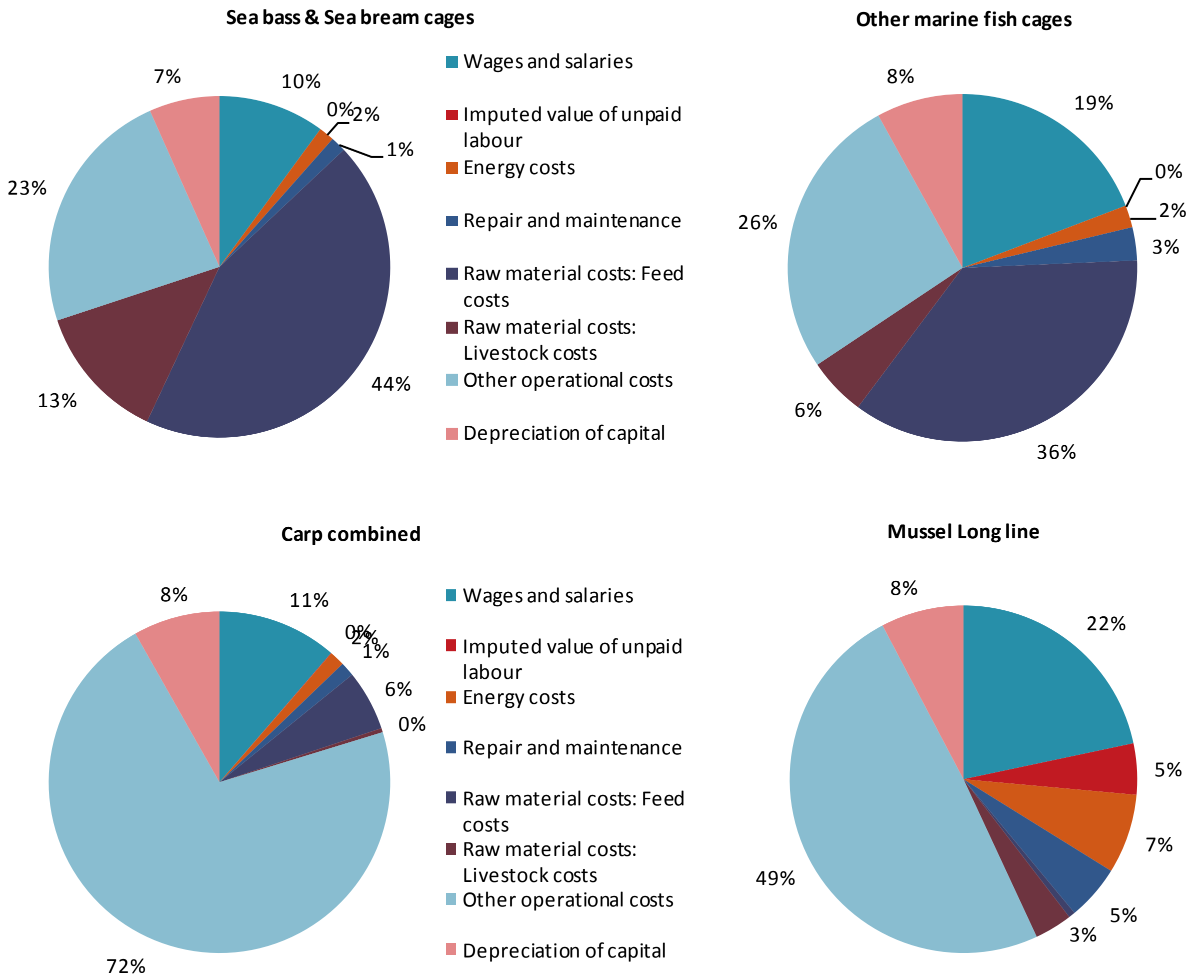


Figure 4.4.8 Cost structure of the main segments in Croatia: 2016.
Source: EU Member States DCF data submission

Segment 3: Other marine fish cages

The net profit margin indicates a negative trend, so as GVA to Revenue. After low performance in 2014, total income so as other economic indicators stabilized, bringing GVA to revenues to lower levels, and keeping Net profit margin stabile. Compared to 2015, costs rose and total income stayed at the same level, which caused slight changes in total results.

Segment 4: Sea bass and Sea bream cages

The largest part of the total costs is feed costs (44%), GVA and net profit margin stayed stabile with slight decrease from 2015 to 2016. Since there have been changes in segmentation, values from previous time series are not completely comparable. Compared to 2015, total income arose in 2016, so as operational costs, which caused the decrease in indicators.

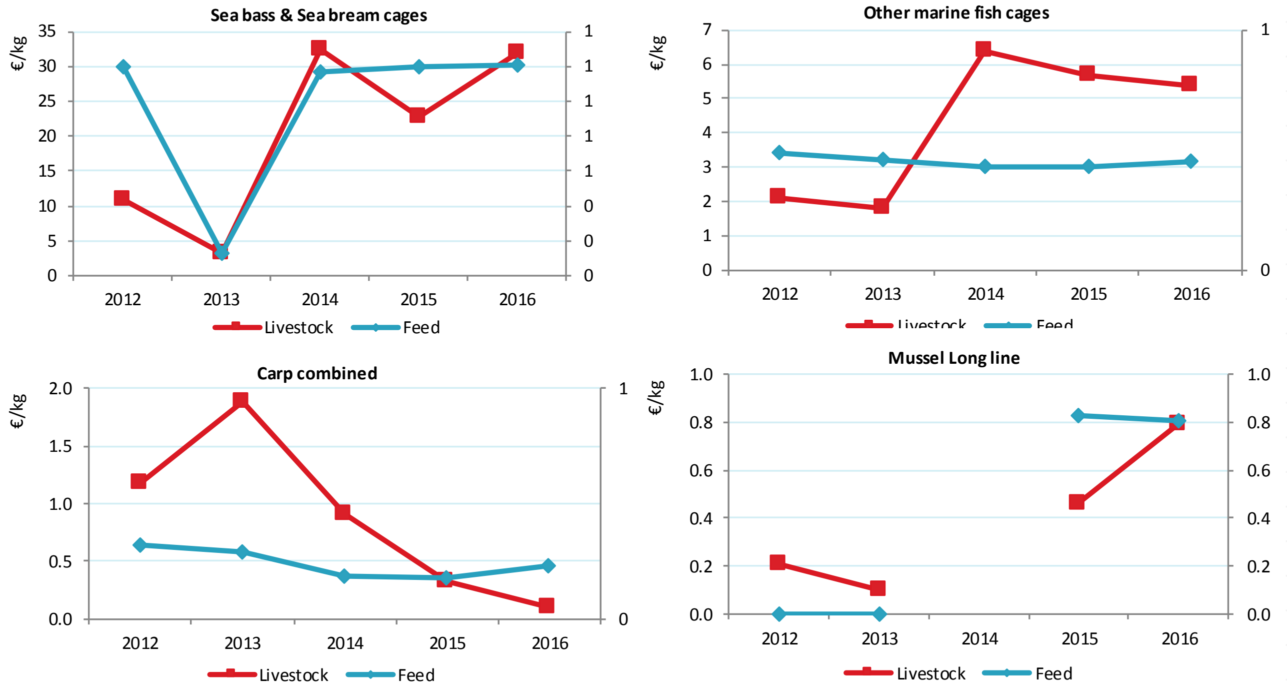


Figure 4.4.9 Feed and livestock prices for the main Croatian segments: 2012-2016.
Source: EU Member States DCF data submission

4.4.5 Trends and triggers

Current production trends and main drivers

The production in Croatia continues to grow. The growth is not equally distributed among the sector, so the biggest improvement was recorded in marine aquaculture, especially in production of sea bass and sea bream. The investments in this segment in past few years encouraged growth in terms of production, but also in diversification of production, which is expected to be visible in the next reporting period. Production of Bluefin tuna is determined by ICCAT quotas and prices on the world market, so this production follows world market trends. It is expected development and further growth in this area.

As expected in previous time series, in past two years, market conditions improved, so about 70% of production is intended for the export. Improvements in technology of farming, so as in system of distribution enabled better availability of aquaculture products for consumers in foreign markets.

Other marine aquaculture segments, Mussels long line and Oysters long line, after lot of investments expect return of investment in upcoming period, especially Mussels long line segment. Although Mussels production has been stable in past period, there is a rise in total income, which implies some returns on investments. Oysters' long line is expected to move towards protected designations of origin and possibility of organic production to encourage growth towards export to EU market.

Freshwater aquaculture, compared to improvements in marine aquaculture and to potential for growth is slightly falling behind. Until now was targeting most on domestic market, and now most enterprises are trying to break into to EU market as there is a growing market demand for freshwater aquaculture products. Also, some of the freshwater aquaculture companies focus on diversification of production and preparation of some new species which, for now, address only limited markets and could hardly stimulate a general growth of the sector.

Market structure

The Croatian market went through period of intensive changes and improvements over the last several years. First of all, there has been improvement in public perception of aquaculture products, which is reflected on domestic consumption. Producers are making progress in marketing and production technologies, as well as in processing and placing aquaculture products. This is especially the case with large companies, resulting in increased investments. As the result, export of aquaculture products grew, especially in marine aquaculture production, corresponding to 70% of total production.

Still, the majority of Croatian aquaculture sector consists out of small-scale, family-owned companies, focused on domestic market. Although in last time series Croatian aquaculture has been increasingly concentrated where few large companies are covering the largest share in employment, production and total income, small businesses, often involved in different activities and encouraged by tourism as an important part of tourist offer, have a major role in economic growth and creating new jobs, especially in peripheral and rural areas. The need for joining a producers association has been recognized to raise the competitiveness when assessing the market and there are efforts for improvements of legal requirements in this issue.

Issues of special interest

According to Croatian National Strategic Plan for Aquaculture Development 2014-2020, development of organic and ecological fish growing is placed in square - Opportunities. Together with opportunities, increased aquaculture production created potential environmental issues, which could encourage the transition to organic aquaculture, strongly supported by EMFF funding

In a part of general priorities, among other things, ensuring sustainable development and growth through coordinated regional planning and the providing of the necessary locations for farmers, also locations for supporting infrastructure, the use of environmentally friendly technologies are underline as main tasks.

Considering the insufficiently explored markets, domestic and EU, there is a need to establish effective communication with consumers, and better organization of the sector in terms of setting up producer organizations, a prerequisite for the successful placement of products in the common market and the further development of freshwater aquaculture activities in Croatia. In order to achieve the required cooperation, and to define the needs of the sector, farmers should be organized in producer organizations and develop its own development policy.

Outlook for future production trends

Since Sea bass and sea bream production is representing more than 70% of total Croatian production value, there is strong interest in further development of this sector. Croatian coast line is suitable for further development of marine aquaculture in generally, but it is necessary to establish good practice in coastal zone management in order to ensure sustainable development of aquaculture production. This also applies for tuna production and shellfish farms. At the same time, it is necessary to improve market organisation and legal framework to assure further development and control.

It is noticed that some marine aquaculture segments have increased their investment in new technologies, and start with introducing new species beside Sea bass and Sea bream. It can be expected that this trend of diversification will have further development.

In freshwater aquaculture development is restricted by available area, but with successful improvements in production technologies it can be expected to increase in production of cyprinid species in total, especially in some newly introduced species.

In aquaculture, especially in marine aquaculture, over recent years there has been a steady increase in the production of new species due to increased consumption in the domestic market, as well as the stabilization of prices in the EU market, but on the other hand, there is a low purchase price.

According to SWOT analysis of freshwater aquaculture, threats are transmission of disease and the damage from predators. General priorities are establishing and implementing protocols to prevent and control diseases and welfare of aquatic animals in farms, protection and compensation for damages caused by predators.

4.4.6 Data Coverage and Data Quality

Data quality

The account statistics for 2016 is based on the sample of 105 enterprises, which covers 57% of the total population of 187 enterprises. Data for all segments have been collected by census, except shellfish farms, where collection has been based on the probability sampling survey.

Data collection was performed through questioners created for this purpose. To ensure data consistency for all segments, together with definition of each variable in guidelines, link was made to accounting code in balance sheets. Some of variables were collected from Croatian Directorate of Fishery (DoF) database and subsidies register, since it is mandatory for all aquaculture producers in Croatia to report the production in volume and value each year at the farm level. But some of the variables were taken from questioners although it was planned to use DoF data. It was detected that DoF register is not complete and that some information is not suitable for this purpose. Some other variables, e.g. subsidies, were collected through DoF register and questioner. One of the main problems was low response and cooperation. Since some changes regarding data collection have been implemented in legal framework, it is expected to improve results in data collection. This is especially important for some segments with small-scale companies where it will be necessary to put additional effort in future data collection.

Data availability

Data for the aquaculture sector is going to be published on the segment level approximately 12 months after the end of the reference year.

Confidentiality

All segments are distinguished both concerning the species and technique. If an enterprise produces more than one species, then it is allocated to the segment of the species that contributes the most to the turnover.

Some enterprises own more than one farm using different techniques, but these activities are grouped together, because the enterprise is used as data collection unit. There are very few examples of enterprises using more than one production technique.

Differences in DCF data compared with other official data sources

The Croatian data for DCF is, in most cases, in line with both value and production registered in FAO and EUROSTAT. Only in the shellfish production there is significant difference between the data sources. However, explanation for that is probably difference in methodology. While shellfish data delivered for EUROSTAT in 2012 and 2013 are result of Croatian Chamber of Economy and Chamber of Trades and Crafts estimates, on the other hand DCF data for shellfish farms are estimation based on the sample. Regarding marine and freshwater fish production, data between EUROSTAT and DCF are mostly in line. Differences that appear are again the result of different methodology. In 2016 and 2015, total quantity and volume corresponds to quantity and volume reported by Eurostat. However, since quantities and volume for DCF are calculated from aquaculture segments, a part of mussel production ended up in marine fish volume (12 203.21 EUR and 11.477 tonnes in 6.4. Other marine fish cages and €23 461.66 and 21.077 tonnes in 3.4. Sea bass and Sea bream cages for 2016 and €9 487.21 and 8.944 Tonnes 6.4. Other marine fish cages and €177 896.04 and 116.816 Tonnes in 3.4. Sea bass and Sea bream cages for 2015) Also, while data delivered for EUROSTAT refers only on market size commercial fish for human consumption, in the DCF data eggs, larva and juveniles are also enrolled with result of production per species. Furthermore, data for some of the segments from the freshwater aquaculture could not be presented due to confidentiality.

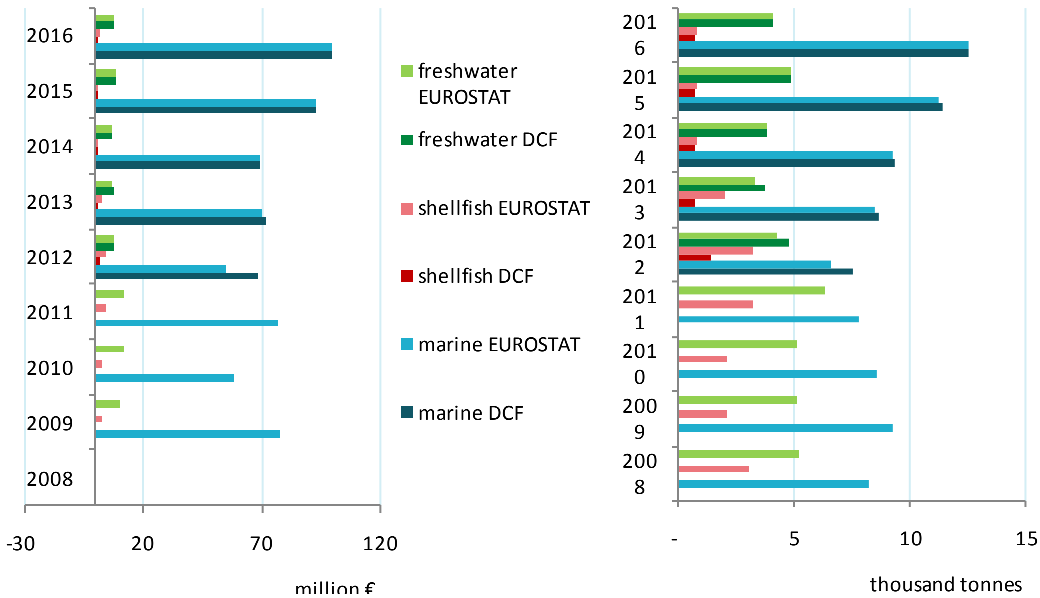


Figure 4.4.10 Comparison of DCF data with EUROSTAT data for Croatia: 2012-2016

4.5 Cyprus

The aquaculture industry in Cyprus is mainly based on marine fish production, European seabass and Gilthead seabream. Due to production threshold, the country is not expected to provide economic data for this report.

Production volume and value

The Cypriot aquaculture produced 6.6 thousand tonnes in 2016 and the estimated production value was €36.2 million (Eurostat, 2018) with freshwater aquaculture being a very small part of the production.

The production volume in 2016 rose by 48% since 2008 and by 21% since 2015. Accordingly, production value in 2016 rose (but to a lesser extend) by 38% since 2008 and by 12% since 2015. The value of the production in 2016 increased by 2% compared to 2015 and 21% compared over the period 2008-2016. The development over the last 9 years shows an increase in production of marine species, while the production of freshwater species has diminished by 32% both in volume and value.

The production of hatcheries has also increased significantly by 120% since 2008 from 13 million units, to 34 million units in 2016.

Table 4.5.5 Production and sales for Cyprus: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 15-16	Develop. 2016/(08-15)
Production weight (thousand tonnes)	***3.8***	***3.4***	***4.1***	***4.7***	***4.3***	***5.3***	***4.8***	***5.5***	***6.6*** ▲	***21%***	▲ ***48%***
Marine	3.7	3.3	4.0	4.6	4.3	5.3	4.8	5.4	6.6 ▲	*22%*	▲ *49%*
Shellfish											
Freshwater	0.06	0.08	0.07	0.07	0.06	0.05	0.04	0.04	0.04 ▼	*-8%*	▼ *-32%*
Production value (million €)	***33.1***	***16.5***	***20.3***	***27.3***	***23.6***	***29.2***	***27.8***	***32.3***	***36.2*** ▲	***12%***	▲ ***38%***
Marine	32.8	15.8	19.8	26.8	23.1	28.7	27.4	31.9	35.9 ▲	*12%*	▲ *39%*
Shellfish											
Freshwater	0.38	0.69	0.52	0.56	0.50	0.48	0.39	0.35	0.33 ▼	*-7%*	▼ *-33%*
Hatcheries & nurseries (million units)	***13***	***13***	***12***	***0***	***0***	***18***	***30***	***37***	***34*** ▼	***-9%***	▲ ***120%***
Eggs	13	13	12			18	30	37	34 ▼	*-9%*	▲ *65%*
Juveniles											

SOURCE: EUROSTAT

Main segments

Based on the 2016 report, the main cultured marine species in Cyprus are seabream (*Sparus aurata*), seabass (*Dicentrarchus labrax*), meagre (*Argyrosomus regius*) and other fish in much smaller quantities (such as *Siganus rivulatus* and *Pagellus erythrinus*). In fresh water the species cultured are rainbow trout (*Oncorhynchus mykiss*) and sturgeon (*Asipenser baeri*).

Sea bream is the main specie cultured in Cyprus and accounts for 76% of the total volume and 70% of total value of production in 2016. Sea bass on the other hand accounts for 23% of the total volume and 28% of the value produced in 2016. Other species produced are of less importance and account for 2% and 3% of the volume and value produced during 2016 respectively.

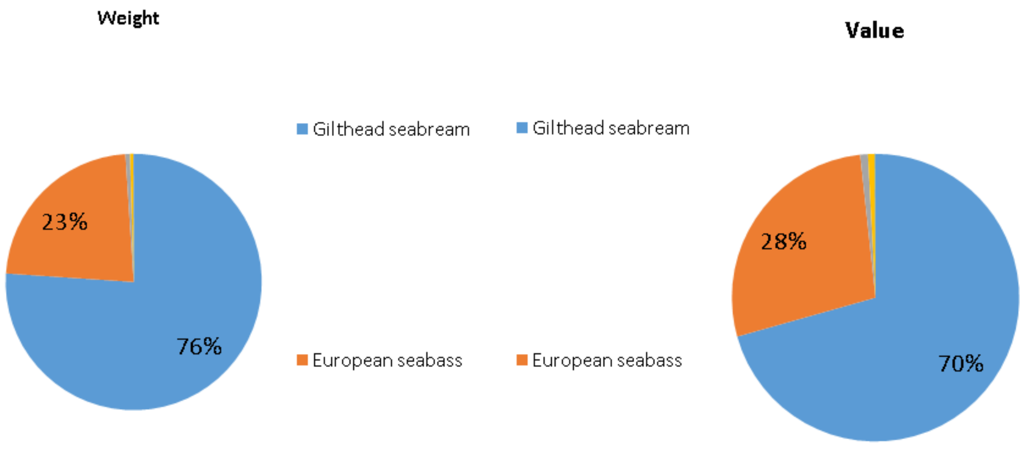


Figure 4.5.*11* Main species in terms of weight and value in Cypriot production: 2016.
Source: EUROSTAT

The average price of seabream increased from €4.8/kg in 2008 to reach €5.1/kg in 2016, slightly lower than the price during 2015. The average price of seabass has increased to a greater extent from €5.6/kg in 2008 to €6.6/kg in 2016 again slightly lower than the price during 2015. The average price of rainbow trout increased since 2008 to reach €7.1/kg in 2016.

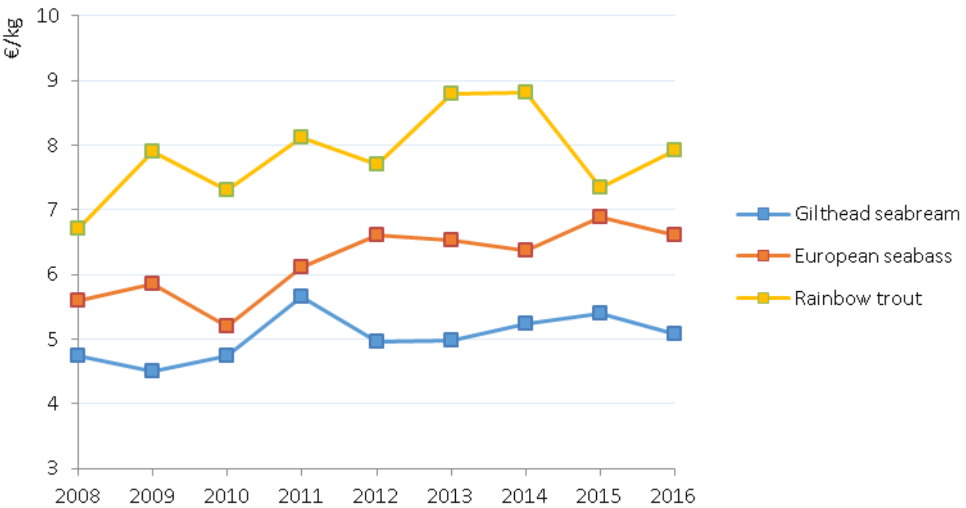


Figure 4.5.12 Average prices for the main species produced in Cyprus: 2008-2016.
Source: EUROSTAT

4.5.1 Data Coverage and Data Quality

Due to production threshold, the country is not expected to provide economic data for this report. Data for the Cypriot aquaculture sector is therefore provided by Eurostat.

4.6 Czech Republic

The Czech Republic is a country with a long tradition of fish farming. Being a landlocked country, only freshwater species can be risen in the country. Aquaculture production in the Czech Republic is generally characterized by extensive and semi-intensive fish farming in ponds. There are 52 000 ha available for fish farming, of which 41 000 ha are used for fish production.

Annual fish production currently fluctuates between 19 000 to 20 000 tonnes, representing about €40 million in value. Common carp is the dominant fish produced (88%). Other cultured fish includes grass carp, silver carp, tench, whitefish and predators such as pike, zander, catfish, perch and salmonids such as trout.

Carp aquaculture is based on a seasonal demand, with the peek at Christmastime and very low sale levels for the rest of the year. This activity results in an important seasonal employment demand and additional sources of income in rural areas. The quality of domestic products is high. Several products are trademarked (Czech carp) or carry the protected geographical indication or protected designation of origin labels.

The strengths of the Czech aquaculture sector are advanced and effective breeding know-how based on traditional carp farming and high-quality breeding material.

Production volume and value

Total aquaculture production in the Czech Republic was 21 thousand tonnes in 2016 which represents a small 4% increase with regard to the previous year, and maintains the production levels around 20 thousand tonnes in the period between 2008 and 2015.

The stable trend in production volumes is not replicated in the case of value. An increase of 34% in the last observed year, 22% in the full period, indicates a rise in prices. Imports from inside and outside the EU, have contributed to an increase in supply of fish in the last years.

Egg production is always difficult in extensive inland aquaculture. Despite the majority of farmers produce their own eggs, there is an active market for freshwater fish eggs in Eastern Europe which includes human consumption and other usages. This alternative market for carp eggs may help with understanding the variations in the production levels recorded in the table. Moreover, 483 units of eggs and juveniles (mostly juveniles) were produced in 2016, i.e. 8% increase compared to the previous year.

Table 4.6.1 Production and sales for the Czech Republic: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 15-16	Develop. 2016/(08-15)
Production weight (thousand tonnes)	***20.4***	***20.1***	***20.4***	***21.0***	***20.8***	***19.4***	***20.2***	***20.2***	***21.0***	***4%***	***3%***
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Freshwater	20.4	20.1	20.4	21.0	20.8	19.4	20.2	20.2	21.0	*4%*	*3%*
Production value (million €)	***41.5***	***39.3***	***37.1***	***39.9***	***36.8***	***35.3***	***42.5***	***35.0***	***47.0***	***34%***	***22%***
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Freshwater	41.5	39.3	37.1	39.9	36.8	35.3	42.5	35.0	47.0	*34%*	*22%*
Hatcheries & nurseries (million units)		***620***	***520***	***532***	***301***	***384***	***395***	***448***	***483***	***8%***	***6%***
Eggs		620	124	127	47	47	27	23	26	*14%*	*-82%*
Juveniles		0	396	405	254	337	368	426	457	*7%*	*46%*

SOURCE: EUROSTAT

Main segments

Common carp concentrates the 88% of the total aquaculture production in weight and the 82% in value. Other species farmed in the country are other carps, like grass or silver carps, and trout. Trout production is formed of rainbow and brook trout. The contribution to total production of these minor species is about 2% in volume and 3% in value of the production.

Figure 4.6.1 Main species in terms of weight and value in the Czech Republic production: 2016.
Source: EUROSTAT

In 2016, there has been a significant increase in the prices of all species. The highest prices are observed for trout species, with an average in 2011-2016 of around €3.6 per kilo. The average price for brook trout in 2016 was €3.9 per kilo and it has increased 7% since 2015. Common carp prices increased from €1.8 per kilo average in 2008-2015 to €2.1 per kilo in 2016. Prices for grass carp were stable during 2008-2015 with average €1.9 per kilo and increased in 2016 to €2.6 per kilo.

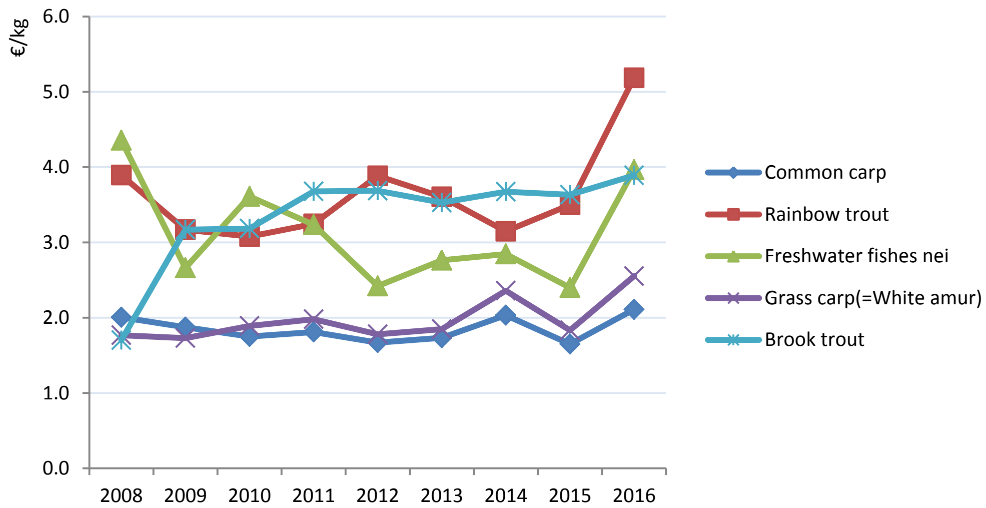


Figure 4.6.2 Average prices for the main species produced in the Czech Republic: 2008-2016.
Source: EUROSTAT

4.6.1 Data Coverage and Data Quality

The Czech Republic is a landlocked country producing only freshwater aquaculture products. The freshwater data collection is not mandatory under the DCF and optionally in EU-MAP, so landlocked countries are therefore not requested to provide economic data for this report. Data for the aquaculture sector is therefore provided by Eurostat.

4.7 Denmark

4.7.1 Production and sales

In total, the Danish aquaculture sector produced 48 200 tonnes in 2016, which is a decrease of 4% from 2015 due to a decrease in production in marine aquaculture from 2015 to 2016. However, it is an increase of 4% from 2014 to 2016. The total value of the production was €185 million in 2016, which is an increase of 1% from 2015 and an increase of 16% from 2014 to 2016. Compared to the average from 2008 to 2015, the total volume increased by 7%, whereas the total sales value increased by 23%.

Table 4.7.1 Production and sales for Denmark: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/(08-15)
Sales weight (thousand tonnes)	***44.1***	***47.5***	***42.6***	***38.9***	***44.2***	***46.3***	***46.4***	***50.1***	***48.2***	*-4%*	*7%*
Marine	7.9	12.1	11.0	10.8	14.0	13.3	14.1	14.5	12.6	*-13%*	*3%*
Shellfish	1.5	2.5	1.1	0.8	1.1	0.8	1.6	1.7	1.7	*-1%*	*22%*
Freshwater	34.7	32.8	30.4	27.3	29.1	32.2	30.8	33.9	33.9	*0%*	*8%*
Hatcheries & nurseries											
Sales value (million €)	***130.0***	***135.0***	***136.1***	***145.8***	***155.0***	***161.7***	***159.8***	***182.9***	***185.0***	*1%*	*23%*
Marine	36.2	41.3	45.9	49.8	57.2	62.9	57.4	61.0	62.4	*2%*	*21%*
Shellfish	1.3	1.7	0.7	0.5	0.9	0.8	1.3	1.2	1.3	*5%*	*23%*
Freshwater	92.5	92.0	89.5	95.5	96.9	98.0	101.0	120.6	121.3	*1%*	*23%*
Hatcheries & nurseries											

Source: EU Member States DCF data submission

4.7.2 Industry structure and employment

In 2016, the total population of aquaculture farms was 211, distributed amongst 107 enterprises. The sector is dominated by small enterprises with less than 5 employees corresponding to 83% of the enterprises in 2016.

Table 4.7.2 Structure of the Danish aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/(08-15)
Structure (number)											
Total enterprises	*162*	*160*	*154*	*135*	*130*	*130*	*115*	*110*	*107*	*-3%*	*-22%*
<=5 employees	141	141	138	118	117	115	99	92	89	*-3%*	*-26%*
6-10 employees	13	9	4	6	4	8	2	6	5	*-17%*	*-23%*
>10 employees	8	10	12	11	9	7	14	12	13	*8%*	*25%*
Employment (number)											
Total employees	*606*	*490*	*468*	*477*	*490*	*513*	*506*	*498*	*549*	*10%*	*8%*
Male employees	530	432	412	427	440	463	450	446	491	*10%*	*9%*
Female employees	76	58	56	50	50	50	56	52	58	*12%*	*4%*
FTE	349	311	282	292	304	311	336	356	366	*3%*	*15%*
Male FTE	305	274	248	262	273	281	299	319	327	*3%*	*16%*
Female FTE	44	37	34	30	31	30	37	37	39	*5%*	*12%*
Indicators											
FTE per enterprise	2.2	1.9	1.8	2.2	2.3	2.4	2.9	3.2	3.4	*6%*	*44%*
Average wage (thousand €)	61.1	71.1	75.3	71.7	72.4	72.6	72.1	71.8	65.7	*-9%*	*-7%*
Labour productivity (thousand €)	87.6	90.1	124.8	126.4	127.1	126.2	108.7	112.7	122.7	*9%*	*9%*

Source: EU Member States DCF data submission

The total number of persons employed in 2016 was 549, corresponding to 366 FTEs. From 2015 to 2016, the number of employees increased by 10%, compared to the average from 2008 to 2015, the number of persons employed has increased by 8%. In 2016, only 11% of the employees in the sector were women. The average FTE per enterprise decreased 6% from 2015 to 2016, whereas the average wage decreased by 9% from €71.8 thousand to €65.7 thousand, corresponding to a decrease of 7% when compared to the average from 2008 to 2015.

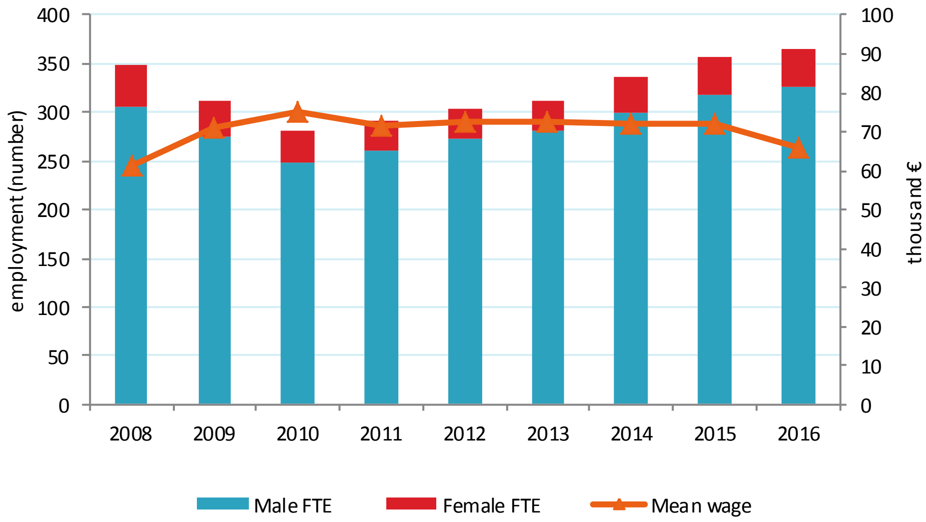


Figure 4.7.1 Employment trends for Denmark: 2008-2016.
Source: EU Member States DCF data submission

The number of enterprises has decreased from 2008 to 2016; however, FTEs have increased over the last 3 years, which in turns means that the average number of FTE per enterprise has been increasing over the same period. In 2016 the average wage decreased by 9% compared to 2015 and 7% compared to the average of the period 2008 to 2015. Labour productivity increased by 9% in 2016 measured as gross value added per full time employee. Until 2013 the enterprises have managed to increase labour productivity. From 2013 to 2014, labour productivity decreased by 14%. However, in 2015 and 2016 enterprises managed to increase labour productivity again, and compared to the period 2008 to 2015 increased by 9% in 2016.

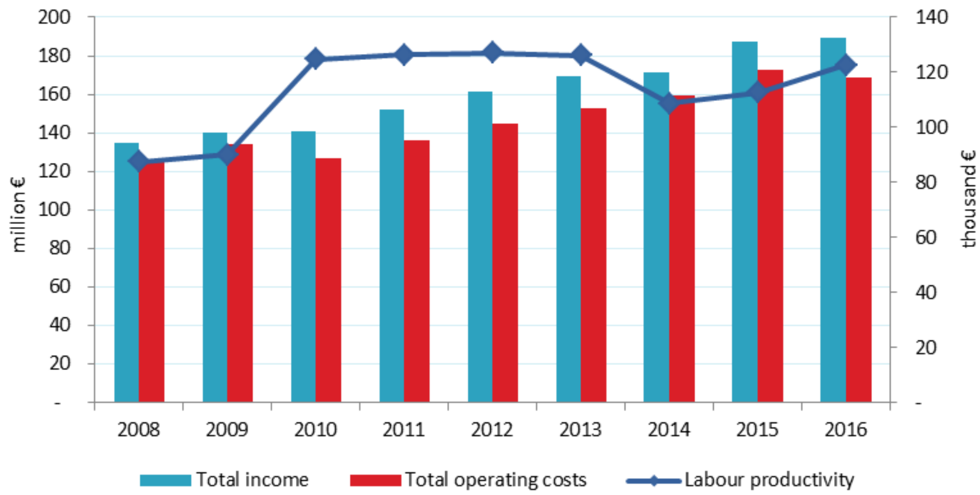


Figure 4.7.2 Income, costs, wages and labour productivity trends for Denmark: 2008-2016.
Source: EU Member States DCF data submission

4.7.3 Economic performance

From 2015 to 2016, total income increased by 1%, while the operational cost decreased by 2%. The total income is dominated by the turnover from the sale of fish from the farms, which contributes 98% of total income, leaving 2% to other sources of income.

Table 4.7.3 Economic performance of the Danish aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	*% of total income*	Change 2016-15	Development 2016/(2008-15)
Income (million €)												
Turnover	130.0	135.0	136.1	145.8	155.0	161.7	159.8	182.9	185.0	*98%*	*1%*	*23%*
Other income	4.8	5.2	4.8	6.0	6.5	7.8	11.6	4.4	4.4	*2%*	*-1%*	*-31%*
Subsidies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*	*0%*
Total income	*134.8*	*140.1*	*140.9*	*151.8*	*161.5*	*169.6*	*171.4*	*187.3*	*189.4*	*100%*	*1%*	*21%*
Expenditures (million €)												
Wages and salaries	16.5	16.2	15.6	15.8	17.0	17.5	19.4	20.9	19.3	*10%*	*-7%*	*11%*
Imputed value of unpaid labour	4.9	5.9	5.6	5.1	5.0	5.1	4.9	4.7	4.7	*2%*	*0%*	*-8%*
Energy costs	6.4	6.8	6.5	7.1	7.7	7.2	7.1	7.7	7.7	*4%*	*0%*	*9%*
Repair and maintenance	4.7	4.3	4.7	5.7	5.6	5.3	5.9	5.6	6.0	*3%*	*9%*	*15%*
Raw material: Feed costs	45.7	43.3	41.3	49.7	50.7	54.5	58.1	59.9	55.7	*29%*	*-7%*	*11%*
Raw material: Livestock costs	24.1	34.9	32.0	31.2	34.8	38.8	36.4	46.6	45.0	*24%*	*-4%*	*29%*
Other operational costs	23.3	22.8	21.3	21.2	24.0	24.4	27.4	27.4	30.1	*16%*	*10%*	*26%*
Total operating costs	*125.5*	*134.2*	*127.0*	*135.9*	*144.8*	*152.9*	*159.1*	*172.7*	*168.6*	*89%*	*-2%*	*17%*
Capital Costs (million €)												
Depreciation of capital	6.5	7.9	7.2	6.3	7.3	7.1	6.6	6.9	8.7	*5%*	*27%*	*25%*
Financial costs, net	7.0	6.1	6.5	3.9	4.2	2.8	2.7	3.6	2.4	*1%*	*-31%*	*-47%*
Extraordinary costs, net	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*	*0%*
Capital Value (million €)												
Total value of assets	193.8	188.1	175.7	168.1	165.8	174.8	182.5	203.6	204.8	*108%*	*1%*	*13%*
Net Investments	13.1	7.9	9.1	10.7	5.5	14.3	14.9	12.0	9.6	*5%*	*-19%*	*-12%*
Debt	149.3	147.2	132.1	118.7	111.6	113.5	128.0	140.1	139.9	*74%*	*0%*	*8%*
Input & Production (thousand tonnes)												
Raw material: Feed	42.6	38.5	38.6	40.0	42.6	41.8	44.0	45.4	42.7		*-6%*	*2%*
Raw material: Livestock	7.3	11.2	9.7	8.6	9.0	11.9	9.1	12.7	11.8		*-7%*	*19%*
Performance Indicators(million €)												
Gross Value Added	30.6	28.0	35.2	36.9	38.6	39.2	36.5	40.1	44.9	*24%*	*12%*	*26%*
Operating cash flow	9.3	5.9	13.9	16.0	16.6	16.7	12.3	14.5	20.8	*11%*	*43%*	*59%*
Earning before interest and tax	2.8	-2.0	6.7	9.7	9.4	9.6	5.7	7.7	12.1	*6%*	*58%*	*96%*
Net profit	-4.3	-8.1	0.2	5.7	5.2	6.8	3.1	4.1	9.7	*5%*	*135%*	*510%*
Capital productivity (%)	15.8	14.9	20.0	22.0	23.3	22.5	20.0	19.7	21.9		*11%*	*11%*
Return on Investment (%)	1.4	-1.1	3.8	5.7	5.7	5.5	3.1	3.8	5.9		*57%*	*69%*
Future Expectation Indicator (%)	3.4	0.0	1.0	2.6	-1.1	4.1	4.6	2.5	0.5		*-82%*	*-79%*

Source: EU Member States DCF data submission

In 2016 the expenditures are dominated by cost of feed (33%), cost of livestock (27%) and cost of wages and salaries (11%). The expenditures on feed have decreased by 7% and expenditures on livestock have decreased by 4%. Expenditures on wages and salaries have decreased by 7% compared to 2015. The total expenditures make up for 89% of the total income.

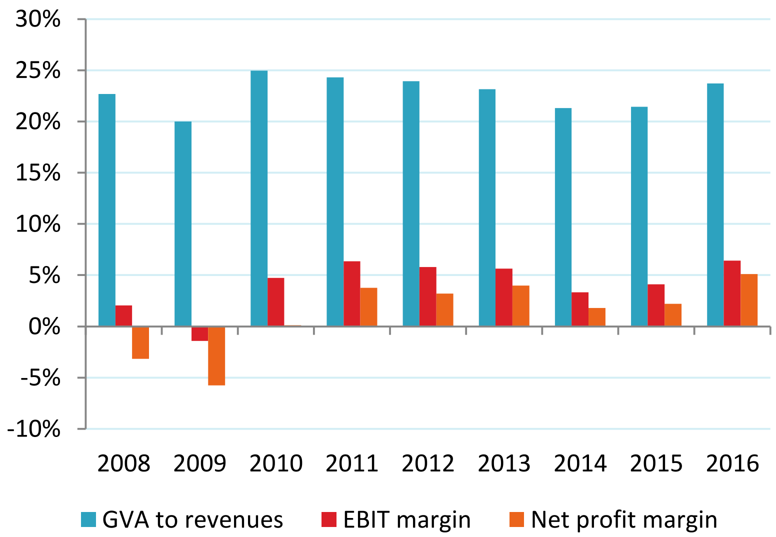


Figure 4.7.3 Economic performance for Denmark: 2008-2016
Source: EU Member States DCF data submission

The gross value added for the sector as a whole increased by 24% and both EBIT and net profit were positive. The total value of assets increased by 1% and debts remained at the same level. The net investment decreased 19% and is now 12% under the average from 2008 to 2015.

4.7.4 Main species produced and economic performance by segment

The production in Denmark can be divided into four main segments based on the species produced and the technique used.

The largest segment is the land based production of trout, which consists of a combination of hatcheries, nurseries and grow-out farms.

The second most important segment is the marine production of trout and trout eggs, which are produced in sea cage farms. The third segment consists of land based recirculation farms producing European eel, pike-perch, salmon and turbot and the fourth segment produces blue mussels on long lines.

Figure 4.7.4 Main species in terms of weight and value in BulgarianDanish production: 2016.
Source: EU Member States DCF data submission

In Denmark, the land based fresh water aquaculture production is mainly located in Jutland. The marine production of trout is located in the Baltic Sea along the southern coast of Jutland and a few production sites along the coast of Zealand. The production of blue mussels is located in the Baltic Sea and fjords along the coast of Jutland.

The Danish sector is dominated by one species; rainbow trout. The production volume of trout was 48 200 tonnes with a corresponding income of €185 million in 2016.

The second most important species is European eel, which makes up 10% of the total value but only 8% of the volume. Blue mussels make up 3% of the total weight of production, but the value is only 1%.

The portion sized fresh water rainbow trout is mainly exported to Germany, whereas trout eggs harvested from the marine sea cage farms are exported to Japan. Eel, pike perch and turbot are exported to other EU countries.

Large trout produced in cages in marine waters follow the price of salmon, which has been increasing over the period from 2008 to 2011 but then decreased slightly in 2012. However, some of the income from the Danish sea cage farms is coming from the production of trout eggs, which are sold to Japan.

The price of blue mussels has been decreasing from 2008 to 2011 but increased slightly in 2012 and 2013. From 2014 to 2016 the price has decreased again. Therefore, mussel farmers in Denmark still are struggling to survive.

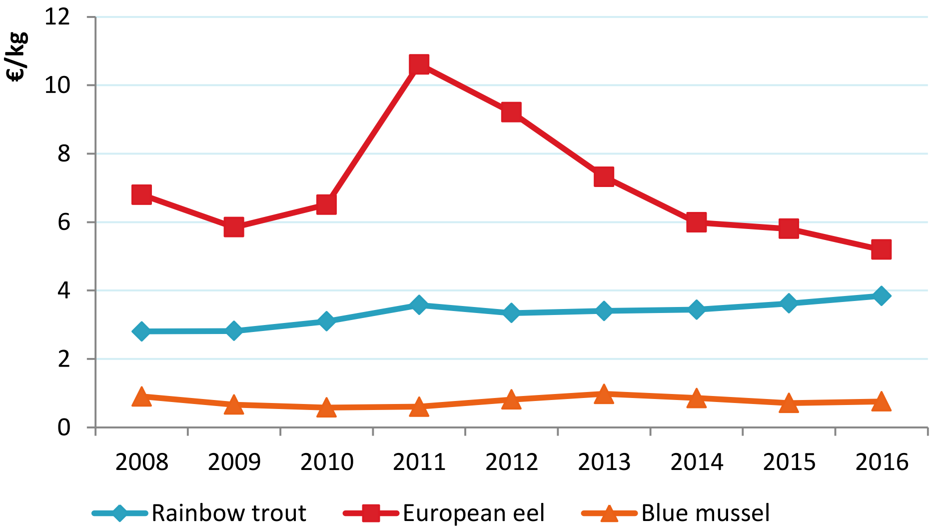


Figure 4.7.5 Average prices for the main species produced in Denmark: 2008-2016.
Source: EU Member States DCF data submission

The most relevant segments in the Danish aquaculture are presented below. The production of trout is divided into two segments based on the technique and production environment.

Segment 1: Trout combined

The most important segment is land based fresh water trout farms (Trout combined). In most cases enterprises in Denmark combine the production in hatcheries and nurseries with grow out farms. The techniques used are ponds, raceways and recirculation systems. The product from theses farms are mainly portion size trout 300 to 400 grams with white meat. The segment consists of 88 enterprises running 171 farms. The production volume was 30 180 tonnes with a corresponding income of €102.2 million. This corresponds to 63% of the total production volume and 55% of the total production value in 2016.

The 'Trout combined' segment shows a traditional cost composition for a land based finfish aquaculture industry where the main cost components are feed and livestock, which cover 60% of the total operational costs.

With a 21% net profit increase, the sector performed acceptable.

Segment 2: Trout cages

The second most important segment is the sea cage farms producing trout (Trout cages). The main product, besides the fish meat, is trout eggs. In 2016 there were 19 farms distributed among 5 enterprises. The production volume was 12 600 tonnes bringing about a total income of €62.4 million. This segment covers 26% of the volume and 34% of the value of total Danish production.

In the 'Trout cages' at sea, the cost components feed and livestock are also the most important covering 59% of the total operational costs. In sea cage farming, the cost of livestock is more important than feed, which is the opposite of the composition in the land based farms. The fish (smolt) bought for sea cage productions are larger than for land based production, which explains the difference in the cost compositions. Also the other operational costs are higher due to the cost associated with the transport of feed, fish and equipment to the production site.

A negative net profit in 2015 has been turned to at positive in 2016 with a value of €7.3 million.

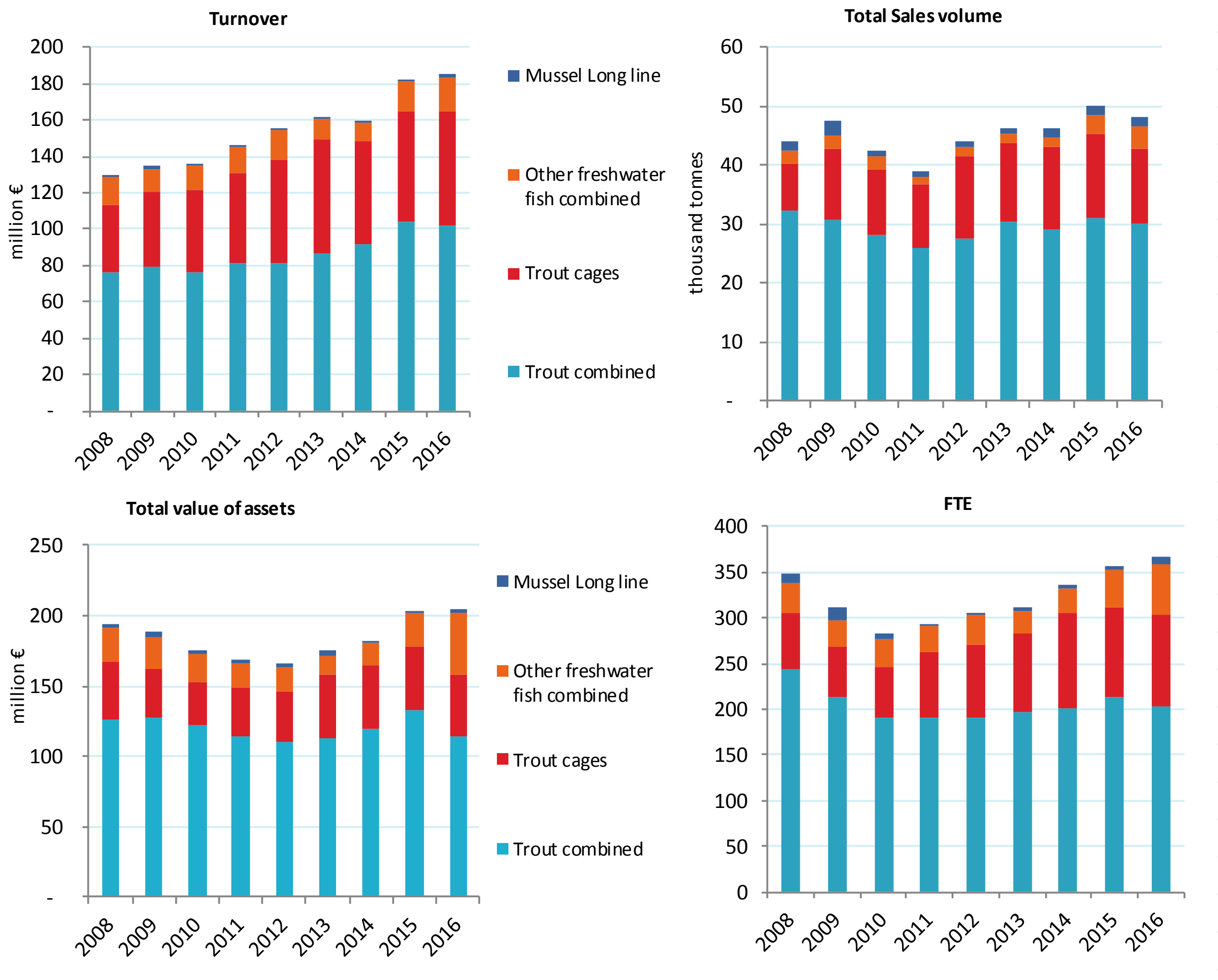


Figure 4.7.6 Structural development Danish aquaculture sector: 2008-2016.
Source: EU Member States DCF data submission

Segment 3: Other freshwater fish species combined

Denmark also has a minor land based production of other freshwater species (Other freshwater fish combined). The main species produced in this segment is European eel in land based recirculation farms. The eel production enterprises are dependent on wild caught glass eel for production. There are 5 enterprises left producing eel representing one farm each. In this segment there are also 3 enterprises running 3 farms with a minor production of pike-perch, turbot and salmon. The production technique is intensive recirculation where more than 95% of the water is recirculated. The production volume was 3 700 tonnes with a corresponding income of €19.2 million in 2016.

In the segment 'Other freshwater fish combined', the main cost components are also feed and livestock, which cover 41% of the total operational costs. The energy cost covers 9% of the total cost, which is twice as much as the segment Trout combined. The reason for the higher energy cost is the use of highly recirculated systems in this segment.

A negative net profit means the sector is performing with a loss for 2016.

Table 4.7.4 Economic performance of main Danish aquaculture segments: 2008-2016 (in million €).

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	*% of total income*	Change 2016/15	Development 2016/(2008-15)
Trout cages												
Total income	36.4	42.7	46.7	51.3	58.2	67.4	61.1	62.3	63.3	100%	2%	19%
Gross Value Added	4.3	3.8	9.5	11.5	11.3	15.6	9.0	7.7	14.6	23%	88%	60%
Operating cash flow	1.1	0.5	6.2	7.5	6.6	10.5	2.7	1.7	9.0	14%	429%	96%
Earning before interest and tax	-0.2	-0.6	5.0	6.2	5.0	8.6	1.1	-0.2	7.2	11%	3398%	132%
Net profit	-1.6	-1.0	3.7	5.9	3.8	8.5	1.0	-1.0	7.3	12%	867%	205%
Total sales volume (thousand tonnes)	7.9	12.1	11.0	10.8	14.0	13.3	14.1	14.5	12.6		-13%	3%
Trout combined												
Total income	81.0	82.6	79.9	85.6	86.1	89.1	98.3	106.7	105.4	100%	-1%	19%
Gross Value Added	21.9	20.7	22.5	22.0	23.0	19.9	24.1	26.1	25.1	24%	-4%	11%
Operating cash flow	6.3	4.9	7.2	7.4	8.2	4.6	8.4	9.6	10.3	10%	7%	46%
Earning before interest and tax	1.9	-0.6	2.3	2.9	3.7	0.1	4.0	5.6	5.5	5%	-2%	122%
Net profit	-2.9	-5.4	-1.9	-0.3	1.1	-2.1	1.8	3.4	4.1	4%	21%	620%
Total sales volume (thousand tonnes)	32.4	30.6	28.3	26.0	27.4	30.6	29.1	31.0	30.2		-3%	3%
Mussel Long line												
Total income	1.4	1.8	0.7	0.5	1.1	0.9	1.4	1.2	1.4	100%	12%	22%
Gross Value Added	0.7	0.6	0.2	0.2	0.7	0.4	1.0	0.8	0.8	57%	-4%	36%
Operating cash flow	0.0	-0.5	-0.3	0.0	0.5	0.1	0.6	0.5	0.3	24%	-34%	230%
Earning before interest and tax	-0.2	-0.9	-0.4	-0.1	-0.1	-0.2	0.5	0.4	0.2	17%	-46%	290%
Net profit	-0.3	-1.2	-0.7	-0.1	-0.3	-0.4	0.4	0.4	0.2	13%	-54%	169%
Total sales volume (thousand tonnes)	1.5	2.5	1.1	0.8	1.1	0.8	1.6	1.7	1.7		-1%	22%
Other freshwater fish combined												
Total income	15.9	13.1	13.7	14.5	16.1	12.1	10.7	17.1	19.4	100%	14%	37%
Gross Value Added	3.7	3.0	3.0	3.2	3.7	3.3	2.5	5.5	4.5	23%	-19%	29%
Operating cash flow	1.8	1.0	0.8	1.2	1.4	1.5	0.5	2.7	1.2	6%	-57%	-16%
Earning before interest and tax	1.2	0.1	-0.1	0.6	0.8	1.0	0.1	1.8	-0.8	-4%	-146%	-220%
Net profit	0.6	-0.5	-0.9	0.2	0.5	0.8	-0.2	1.3	-2.0	-10%	-254%	-937%
Total sales volume (thousand tonnes)	2.3	2.2	2.1	1.3	1.7	1.6	1.6	2.9	3.7		28%	88%

Source: EU Member States DCF data submission

Segment 4: Mussels long line

The fourth segment is blue mussels on long lines, which has been introduced in recent years. The production was 1 700 tonnes with a corresponding income of €1.3 million in 2016. The segment had 5 enterprises running 12 farms. The farms are mostly located in Limfjorden in the northern part of Jutland and in fjords along the east cost of Jutland. Blue mussel farming is a relatively new and small segment both in terms of volume and value in the Danish aquaculture sector. The segment is struggling to increase production and productivity, but so far the conditions and competition in this sector have not been favourable to the Danish producers. The blue mussel farmers have been represented in The Danish Account Statistics for Aquaculture since 2006. From 2014 and onwards the segment has shown a small positive net profit.

The segment 'Mussel long line' has a completely different cost structure because there is no feed in the production costs. The single most important cost item is Wages and salaries which in 2016 cover 31% of the costs.

The sector is still struggling to earn money and in 2016 net profit decreased 54%.

In Table 4.3.4, the economic performance of the four Danish segments is shown. From the table it can be seen that the gross value added is positive for all segments, but the net profit varies a lot over the period 2008 to 2016. In 2016 all segments except 'Other freshwater fish combined' has a positive net profit. In 2015 however the segment 'Trout cages' had a negative net profit due to high production costs.

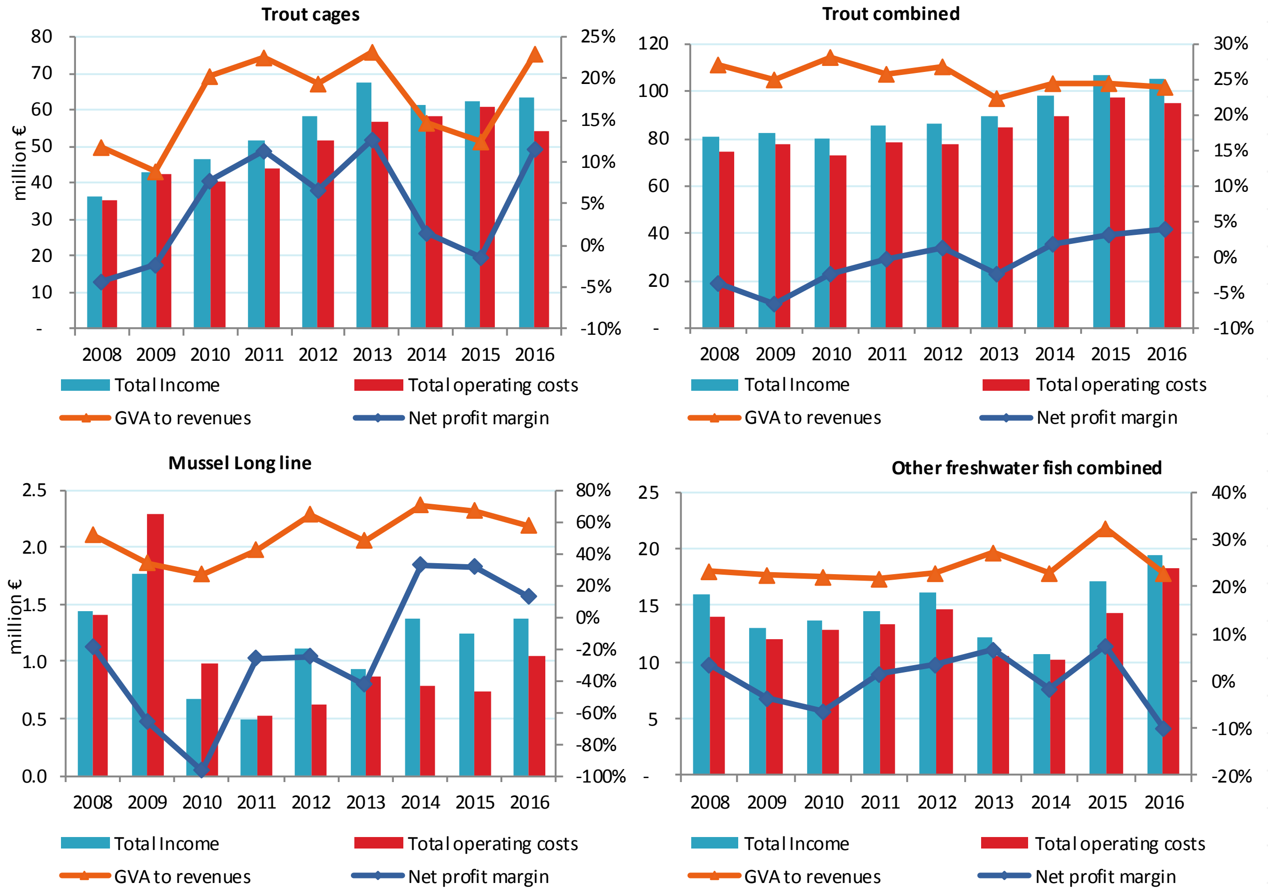


Figure 4.7.7 Economic performance indicators for the main Danish segments: 2008-2016.
Source: EU Member States DCF data submission

In Figure 4.3.7, the economic indicators for the four Danish segments are presented. From the figures it can be seen that net profit margin is positive for all segments including the blue mussel in 2016. Furthermore, in 2016 net profit margin is positive for all segments except 'Other freshwater fish combined' which has experienced negative net profit due to start-up complications of new facilities producing salmon in recirculated facilities.

In Figure 4.3.8, the operational cost structures for the four Danish segments are presented.

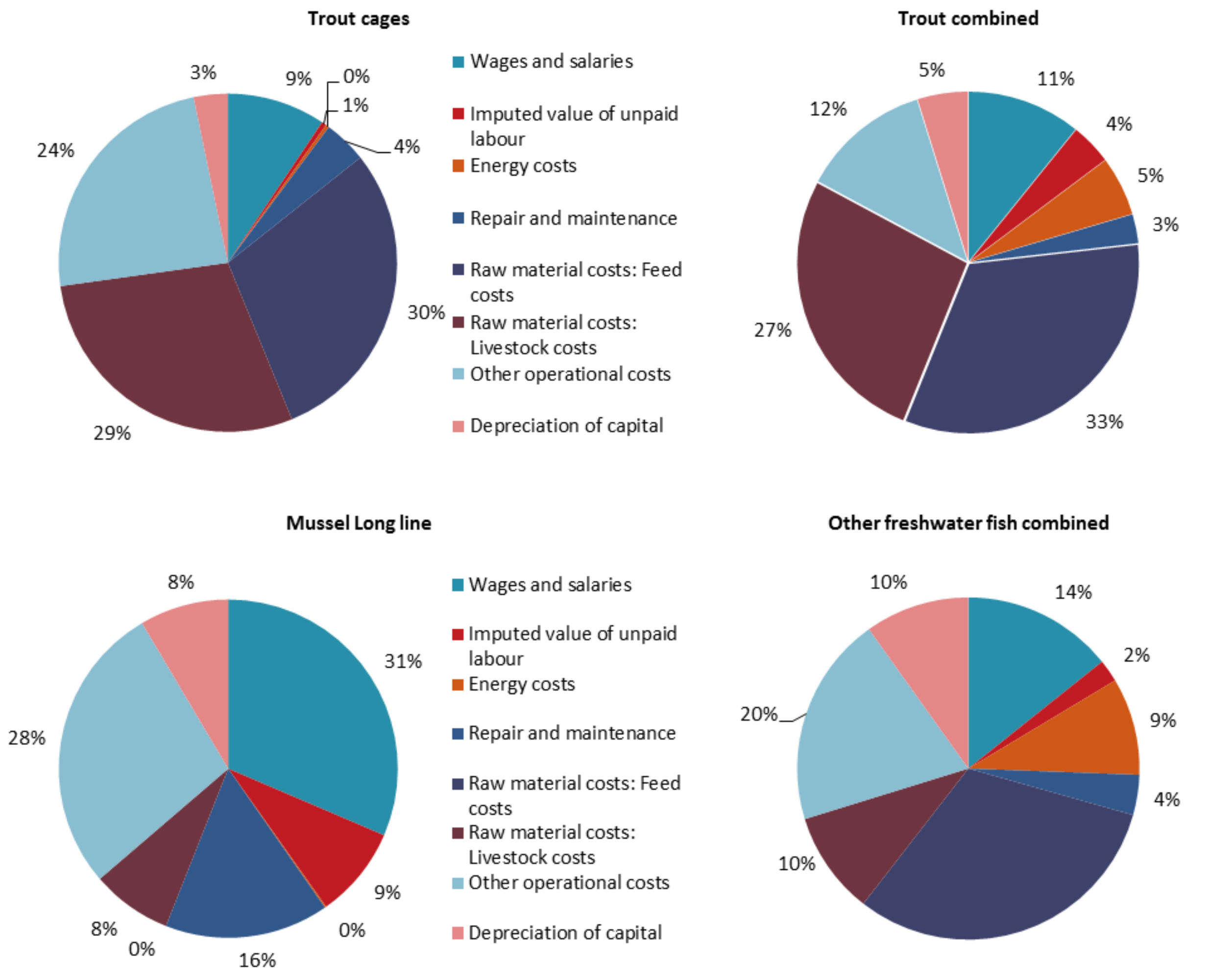


Figure 4.7.8 Cost structure of the main segments in Denmark: 2016.
Source: EU Member States DCF data submission

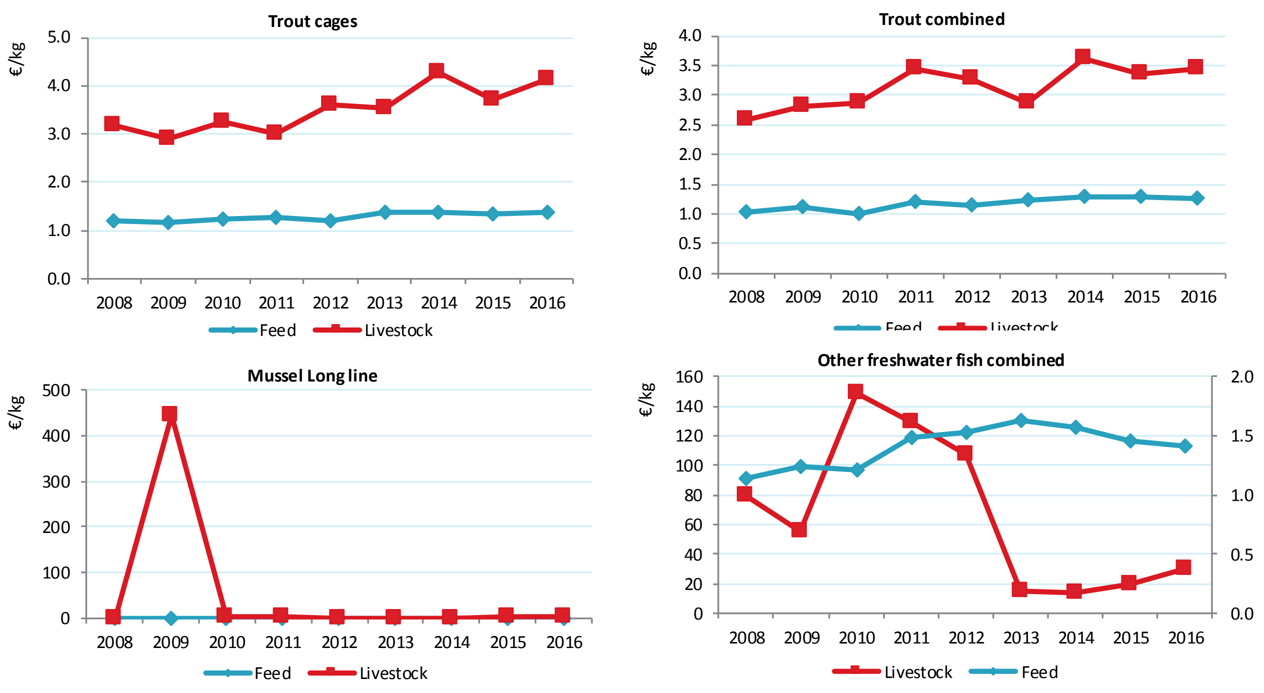


Figure 4.7.9 Feed and livestock prices for the main Danish segments: 2008-2016.
Source: EU Member States DCF data submission

4.7.5 Trends and triggers

Current production trends and main drivers

The main reason for the increase in the marine production in Denmark is the higher prices on larger trout produced in sea cages. The price is driven by the salmon price, which has been high since the disease crisis in Chile. However, to expand the production further the industry needs new licenses. If no new licenses are issued the industry production will stay at the current level of around 13 000 tonnes.

The land based production has shown a downward trend of production over the years. The production was expected to increase slightly when the new regulation going from feed quotas to nitrogen quotas are fully implemented, however, the transition takes time and the results of the change will most likely first show in a couple of years. Furthermore, if the sector is to expand more than a few thousand tonnes, new licenses have to be given to the farmers, otherwise the production will stay at the current level around 30 000 tonnes.

Mussel farming in Denmark is struggling and the future for this segment is very unpredictable. However, mussel and sea weed farming as a mean to reduce the environmental impact from the sea cage farms are expected to grow, if the farms are allowed to expand production.

Market structure

The Danish aquaculture sector has managed to increase labour productivity over the period investigated. The labour cost per unit of output is also relatively low compared to other countries producing trout.

The sector consists of many small producers at the primary level, where there are only two to three enterprises buying and processing the trout. This market structure can be a hindrance because the market is not well functioning and competitive.

In recent years a segment of organic aquaculture producers has been established. In total, there is 21 organic aquaculture producing farms distributed at 12 land based farms and 2 sea cage farms all producing trout and 6 blue mussel farms. The organic producers have higher costs for feed and fry and for water analysis at sea, but they are also receiving a price premium for their products. The segment is producing a little more than 3 000 tonnes, which is an increase of 8% compared to 2015. It is, however, questionable how large the production volume can grow before the price premium will disappear.

Issues of special interest

In Denmark, a few farms are experimenting on the production of new species and using new technology. So far, the most successful project is the production of pike perch in recirculating systems. Furthermore, a minor production of turbot fingerlings exists, where the fingerlings are used for restocking and some are exported to the Netherlands and Spain. New large land based recirculation systems have been set up for the production of Atlantic salmon, trout and Yellow kingfish. In a land based recirculated facility the control of the production process is higher than in a sea cage farm and there is a better opportunity to control the pollution of nitrogen, phosphorus and organic material etc., on the other hand, the operational cost is expected to be higher than in the sea cage farms. When the new farms are fully operational they will produce in excess of 8 000 tonnes per year.

Outlook for future production trends

Before 2012, all farms in Denmark were regulated by a feed quota system. Under this regulation the farmer’s main focus was to optimize production under this restriction of input (feed), whilst the farmer had no incentive to reduce the pollution discharged from the farm. A regulatory change in 2012 to individual pollution rights on nitrogen was implemented to give the farmers an incentive to reduce pollution in order to increase production and profitability. This should also secure a further development and adoption of new environmentally friendly production methods and technologies. It is questionable if this change has had any effect on the production volume in

2015 and 2016, because of the bureaucratic procedures of changing from the old system to the new one, but it is expected that an increase in production volume will be seen in the future.

According the governmental *Strategy for sustainable development of the aquaculture sector in Denmark 2014-2020*[6] the production goal was to be raised by 25% from 44 000 tonnes in 2012 to 55 000 tonnes in 2020. This was to be helped trough means of *Simplifying administrative procedures*, *enhancing competitiveness* and *coordinating spatial planning*.

Even though, the goal for increasing production is less ambitious than in previous plans, it is still questionable whether it will be possible to achieve these goals. From 2012 to 2016, the production volume was raised by 4 000 tonnes from 44 200 to 48 200 tonnes, which was mainly due to an increase of freshwater fish farming. The administrative procedures are still perceived by the farmers to be the main hindrance for raising production volume, as it has been very time consuming to go from the existing feed quota system to the new output based regulation focusing on nitrogen emissions.

The eel farmers are expected to decrease production due to the restriction on the harvesting of glass eels. Furthermore, this restriction drives up prices on glass eels making it less profitable to produce eel. The mussel farmers are expected to increase production and turnover, but it is still questionable if the profit will be positive.

To achieve the goals of the multiannual plan of increasing the production of 25% to 55 000 tonnes two initiatives has been made.

Spatial plans for marine aquaculture growth has been made, and an area in Kattegat has been pointed out. A frame of 800 tonnes of Nitrogen discharge has been granted, which is estimated to correlate to a production of 8 000 tonnes. It is highly doubtful that this target will be reached before 2020 due to lack of time. Increase in marine production therefore seems difficult to achieve before the end of 2020, but might be achievable before end of 2030

An amount around 380 tonnes of Nitrogen discharge has been granted to land based recirculated facilities, which in turn is estimated to correlate to a production of between 10 000 and 15 000 tonnes. Danish Aquaculture organization believes this is an obtainable goal before end of 2020. If no legislative or administrative interference occur, an increase of 10 000 to 15 000 tonnes would fulfill the Danish goals within the planed timeframe.

4.7.6 Data Coverage and Data Quality

Data quality

The account statistic for 2016 is based on a sample of 118 aquaculture farms, which covers 56% of the total population of 211 farms. The sample covers 76% of the total income of the population. Furthermore, data on sales volume and value, purchase of livestock raw material of fish are available for all farms.

The Danish Fisheries Agency (formerly The Danish AgriFish Agency) has registered the total population of farms and enterprises engaged in aquaculture production in Denmark. It is mandatory for all aquaculture producers in Denmark to report the production in volume and value each year at the farm level. Furthermore, the species produced and the technique used in the production is reported.

The data for The Danish Account Statistics for Aquaculture is collected by Statistics Denmark. The collection is based on the total population of farms provided by The Danish Fisheries Agency. The data is collected at farm level, and can be aggregated to the enterprise level. The data is collected at farm level to get the most homogeneous segments in terms of species and technique. The Danish Account Statistics for Aquaculture collects economic data for costs and earnings and

[6] Strategi for bæredygtig udvikling af akvakultursektoren i Danmark 2014-2020.
by: NaturErhvervstyrelsen, Ministeriet for Fødevarer, Landbrug og Fiskeri, Miljøstyrelsen og Naturstyrelsen, Miljøministeriet.

balance sheets. Data is collected on a voluntary basis from the owner's chartered accountant. The accountant's task is to report the accounts of his aquaculture clients to Statistics Denmark in a special form where the account information is harmonized for statistical use. Statistics Denmark validates the data from each account in a specially designed data system for quality control.

The extrapolation of the sample to the total population is done in two steps. In the first step all results from the collected accounts are entered into a database containing information on all existing aquaculture producers in Denmark. From the collected accounts an average is calculated for all indicators in each segment. In the second step, an account for the remaining population is estimated based on the average calculated in the first step and the information collected by the The Danish Fisheries Agency. The underlying assumption for this calculation is that the production function for each farm is identical within each segment. If the production function is identical, the costs and earnings can be distributed from the sales volume and value in each account.

Data availability

Data for the aquaculture sector is published once a year in an aggregated form at farm level for each segment. The aquaculture statistics are published on Statistics Denmark's website approximately 12 months after the end of the reference year.

Confidentiality

The 4 segments that are surveyed in Denmark are presented in Table 4.3.4. To avoid problems with confidentiality, segments should in general include more than 10 enterprises. In Denmark, both the production of the sea cages farms and the production of eel and other species in land based recirculation systems are quite significant in terms of value, and even though these two segments include less than 10 companies, they are surveyed. In order to present detailed data collected from these two segments, nearly all enterprises have agreed to participate in the survey. In the case of eels though, only 2 out of 5 companies report to the DCF. However, all 5 companies report production volume and value to the Danisk Fishery agency, therefore only data regarding production and value are available.

All segments provided by Statistics Denmark have a high degree of homogeneity both concerning the species and technique. At farm level the separation of species into segments is 100%, but if an enterprise produces more than one species, then it is allocated to the segment of the species that contributes the most to the turnover.

Some enterprises own more than one farm using different techniques. In Denmark these activities are split up, because the farm is used as data collection unit. When farms are aggregated into enterprises again, the enterprise is allocated to the segment, where its turnover is highest. There are very few examples of enterprises using more than one technique.

Differences in DCF data compared with other official data sources

The Danish data for DCF is, in most cases, in line with both value and production registered in FAO and EUROSTAT. However, the Danish data for the freshwater sector provided for the DCF also contains value and volume for the Danish hatcheries and nurseries and production of smolts for the sea cage farms. The volume and value therefore exceeds the volume and value registered in FAO and EUROSTAT, which only contains the value and volume for fish for consumption. Furthermore, the value registered for the marine production is also a bit higher due to the income registered for DCF is turnover where the calculated value for the fish in FAO and EUROSTAT is first sale prices of the fish sold.

Furthermore, there are some differences in the volume and value collected by the Danish Fisheries Agency, who reports to EUROSTAT and FAO, and Statistics Denmark which reports to DCF. In general, both volume and value are higher in Statistics Denmark Aquaculture Account Statistics. The reason is that the value and volume in the Account Statistics are measured in enterprise sales, while the numbers from the Danish Fisheries Agency are measured as farm production and revenue as production value in farm gate prices. Secondly, the data collected by Statistics Denmark are account data and the account year does not necessarily coincide with the calendar year.

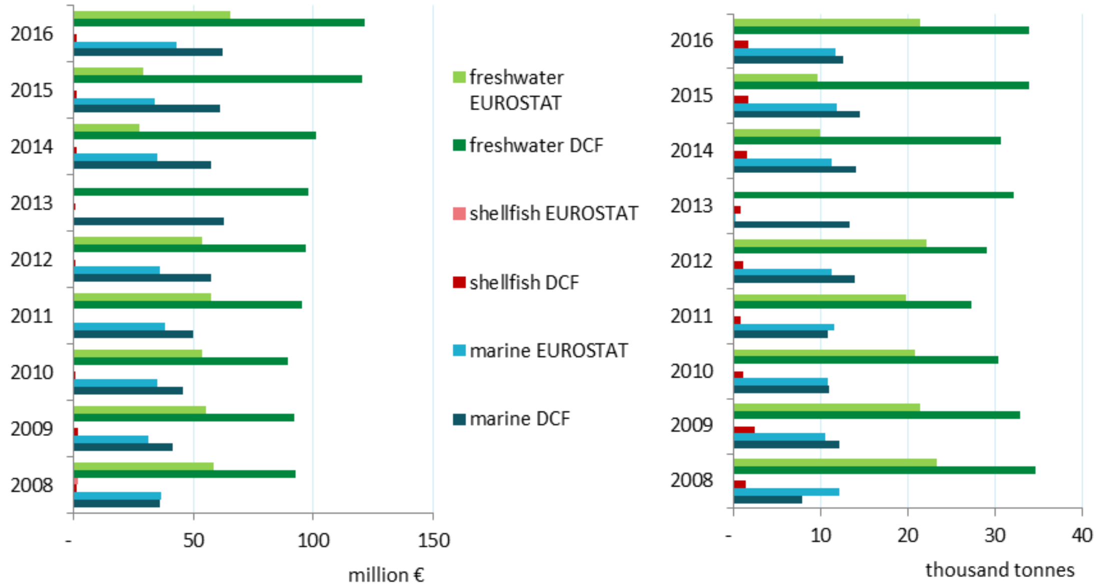


Figure 4.7.10 Comparison of DCF data with EUROSTAT data for Denmark: 2008-2016

4.8 Estonia

4.8.1 *Production and sales*

Enterprises whose primary activity was defined "Fish farming" produced 427 tonnes rainbow trout in 2015, which corresponded to an increase of 17% from 2014 to 2015. On the other hand, the total value of the production was €1.63 million in 2015, which correspond to an increase of 6% over the same period. Compared to the average from 2008 to 2014, the total volume and total sales value increased by 35% and 34%, respectively.

Table 4.8.1 Production and sales for primary trout farming enterprises in Estonia: 2008-2015.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	Change 2015/14	Developm. 2015/(08-14)
Sales weight (thousand tonnes)	***0.3***	***0.4***	***0.3***	***0.2***	***0.3***	***0.3***	***0.4***	***0.4***	*17%*	*35%*
Marine										
Shellfish										
Freshwater	0.3	0.4	0.3	0.2	0.3	0.3	0.4	0.4	*17%*	*35%*
Hatcheries & nurseries										
Sales value (million €)	***1.4***	***1.3***	***1.1***	***0.7***	***1.1***	***1.4***	***1.5***	***1.6***	*6%*	*34%*
Marine										
Shellfish										
Freshwater	1.4	1.3	1.1	0.7	1.1	1.4	1.5	1.6	*6%*	*34%*
Hatcheries & nurseries										

Source: EU Member States DCF data submission

4.8.2 *Industry structure and employment*

In 2015, the total population of primary trout farming enterprises was ten and dominated by small enterprises with less than five employees. 90% of those enterprises had less than five employees.

Table 4.8.2 Structure of the Estonian aquaculture sector (primary trout farming enterprises): 2008-2015.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	Change 2015/14	Developm. 2015/ (08-14)
Structure (number)										
Total enterprises	*8*	*8*	*7*	*7*	*8*	*9*	*9*	*10*	*11%*	*25%*
<=5 employees	8	8	7	7	7	8	8	9	*13%*	*19%*
6-10 employees	0	0	0	0	1	1	1	1	*0%*	*133%*
>10 employees	0	0	0	0	0	0	0	0		*0%*
Employment (number)										*0%*
Total employees	*24*	*20*	*20*	*21*	*28*	*32*	*36*	*36*	*0%*	*39%*
Male employees	17	14	14	15	20	23	26	26	*0%*	*41%*
Female employees	7	6	6	6	8	9	10	10	*0%*	*35%*
FTE	15	12	14	16	24	27	30	30	*0%*	*52%*
Male FTE	11	9	10	12	17	19	22	22	*0%*	*54%*
Female FTE	4	3	4	4	7	8	8	8	*0%*	*47%*
Indicators										*0%*
FTE per enterprise	1.9	1.5	2.0	2.3	3.0	3.0	3.3	3.0	*-10%*	*24%*
Average wage (thousand €)	9.4	9.6	8.3	9.5	9.8	12.1	10.7	10.1	*-6%*	*2%*
Labour productivity (thousand €)	48.7	34.7	15.6	3.6	5.6	-0.5	2.6	5.9	*124%*	*-63%*

Source: EU Member States DCF data submission

The number of enterprises increased by one compared to 2014. The total number of people employed was 36, corresponding to 30 FTEs. From 2014 to 2015, the number of employees remained stable. Compared to the average from 2008 to 2014, the number of persons employed increased 39%. In 2015, 28% of the employees in the sector were women. The average FTE per enterprise decreased by 10% from 2014 to 2015, whereas the average wage decreased by 6% over the same period.

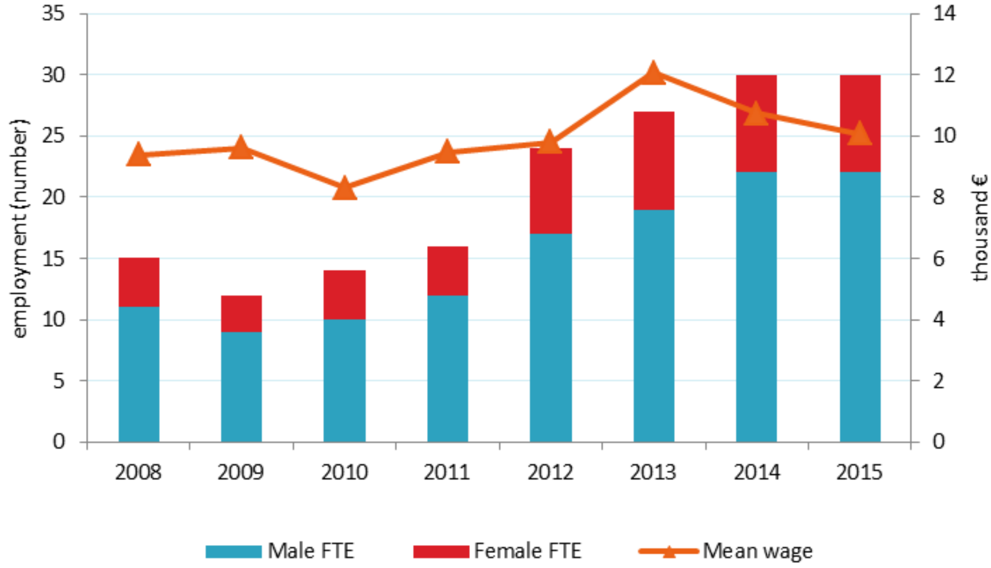


Figure 4.8.1 Employment and wage trends for Estonia (primary trout farming enterprises): 2008-2015.
Source: EU Member States DCF data submission

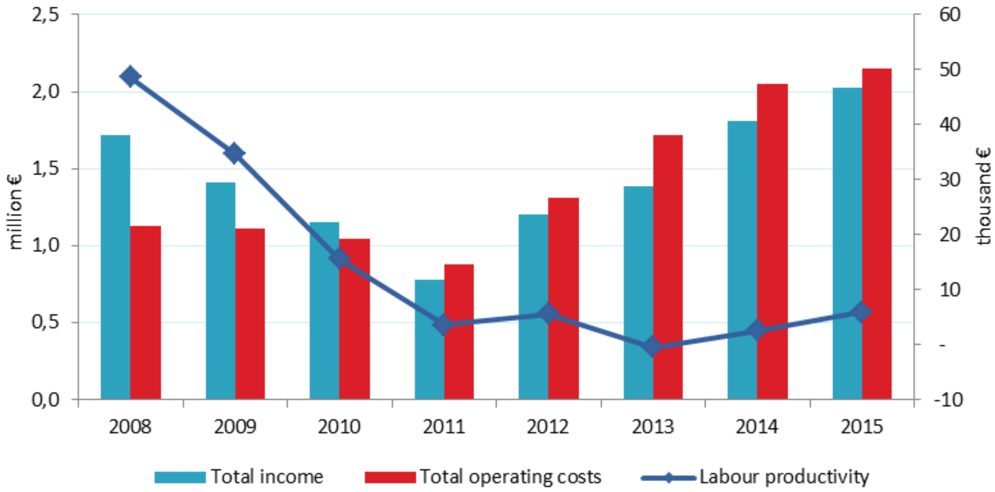


Figure 4.8.2 Income, costs and labour productivity trends for primary trout farming enterprises in Estonia: 2008-2015.
Source: EU Member States DCF data submission

4.8.3 Economic performance

After the heat wave in 2010, which caused a great loss in rainbow trout production, the production volumes of the Estonian trout producers are recovering. Also the starting of production in new trout farms is behind the current figures of economic performance. Due to peculiarities of the aquaculture sector, it will take several years to achieve the capacity of maximum production, while production start-up costs continue to exceed income.

From 2014 to 2015, total income increased by 12%, while the operational cost increased by 5%. Taking into account the share to the total income the expenditures are dominated by cost of feed (45%), other operational costs (28%) and cost of wages and salaries (14%), in 2015. The total expenditures make up for 106% of the total income.

From 2014 to 2015, the gross value added (GVA) increased, but both EBIT and net profit were negative. The total value of assets increased by 6%. Also the net investments and debts had a rise. Around €0.7 million of net investments were made in 2015.

Table 4.8.3 Economic performance of the Estonian aquaculture sector (primary trout farming enterprises): 2008-2015.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	% of total income	Change 2015-14	Development 2015/(2008-14)
Income (million €)											
Turnover	1.4	1.3	1.1	0.7	1.1	1.4	1.5	1.6	80%	6%	34%
Other income	0.3	0.1	0.1	0.1	0.1	0.0	0.3	0.4	20%	47%	188%
Subsidies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0%	0%	0%
Total income	*1.7*	*1.4*	*1.2*	*0.8*	*1.2*	*1.4*	*1.8*	*2.0*	100%	12%	50%
Expenditures (million €)											
Wages and salaries	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.3	14%	-9%	55%
Imputed value of unpaid labour	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1%	30%	17%
Energy costs	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.2	12%	-17%	45%
Repair and maintenance	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	2%	-14%	-12%
Raw material: Feed costs	0.7	0.6	0.6	0.4	0.6	0.6	0.8	0.9	45%	9%	48%
Raw material: Livestock costs	0.1	0.0	0.1	0.0	0.1	0.1	0.1	0.1	3%	-50%	-14%
Other operational costs	0.1	0.1	0.1	0.2	0.2	0.3	0.4	0.6	28%	41%	182%
Total operating costs	*1.1*	*1.1*	*1.0*	*0.9*	*1.3*	*1.7*	*2.1*	*2.2*	106%	5%	63%
Capital Costs (million €)											
Depreciation of capital	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	8%	-20%	26%
Financial costs, net	0.1	0.1	0.0	0.1	0.1	0.2	0.2	0.2	10%	25%	117%
Extraordinary costs, net	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0%	0%	-100%
Capital Value (million €)											
Total value of assets	3.5	3.4	3.0	3.4	7.2	8.9	9.5	10.0	495%	6%	81%
Net Investments	0.1	0.1	0.1	0.6	0.2	0.3	0.1	0.7	33%	768%	214%
Debt	1.4	1.5	1.2	2.2	5.5	5.8	5.7	6.2	309%	9%	88%
Input & Production (thousand tonnes)											
Raw material: Feed	0.5	0.5	0.4	0.3	0.5	0.5	0.6	0.7		7%	38%
Raw material: Livestock	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0		-54%	-68%
Performance Indicators(million €)											
Gross Value Added	0.7	0.4	0.2	0.1	0.1	0.0	0.1	0.2	9%	124%	-24%
Operating cash flow	0.6	0.3	0.1	-0.1	-0.1	-0.3	-0.2	-0.1	-6%	49%	-505%
Earning before interest and tax	0.5	0.2	0.0	-0.2	-0.2	-0.5	-0.4	-0.3	-14%	36%	-208%
Net profit	0.4	0.1	-0.1	-0.2	-0.3	-0.7	-0.6	-0.5	-24%	20%	-162%
Capital productivity (%)	21.0	12.4	7.3	1.7	1.9	-0.1	0.8	1.8		112%	-73%
Return on Investment (%)	14.0	5.8	-0.3	-5.0	-3.0	-5.5	-4.6	-2.8		40%	-1428%
Future Expectation Indicator (%)	-1.4	0.4	-1.5	16.1	1.6	2.1	-1.2	5.2		539%	127%

Source: EU Member States DCF data submission

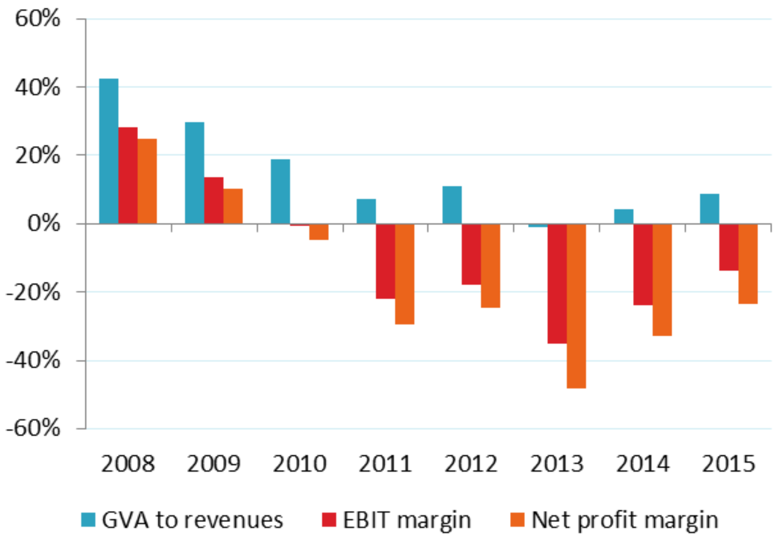


Figure 4.8.3 Economic performance for Estonia (primary trout farming enterprises): 2008-2015
Source: EU Member States DCF data submission

4.8.4 Main species produced and economic performance by segment

According to the Eurostat the rainbow trout is the main species produced by the Estonian aquaculture sector, representing 70% (559 tonnes) in quantity and 59% (€2 million) in value of total production in 2015. Other less important fish species are eel, common carp and sturgeons. Additionally, a few enterprises provide very limited production of some local fish species mainly for restocking. Salmonids are reared for restocking by two state-financed farms. Also crayfish farms are operating in Estonia.

The average price for trout produced in Estonia decreased in 2009. This decrease was probably due to the economic crisis. However, the average price has been increasing from 2009 to 2014. In 2015, the average price made through slight decrease.

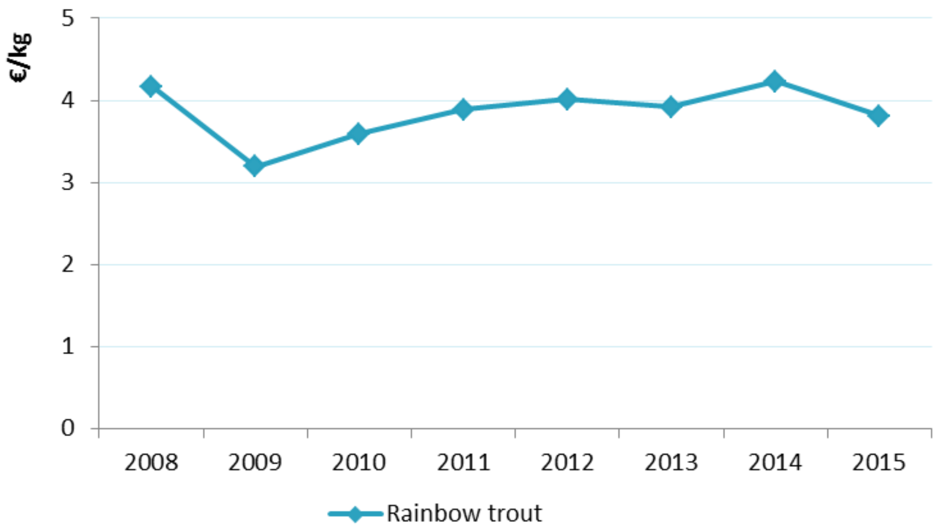


Figure 4.8.4 Average prices for the main species produced in Estonia: 2008-2015.
Source: EU Member States DCF data submission

The production of trout is divided into two segments based on the technique. Those segments are described below.

Segment 1: Trout combined

The most important segment was land based fresh water trout combined farms in 2015. In most cases enterprises in Estonia combine the production in hatcheries and nurseries with grow out farms. The segment consists of six enterprises. The production volume was 397 tonnes with a corresponding income of €1.5 million. The production volume and the value account for 93% of the total trout production.

Segment 2: Trout on growing

The second segment was land based fresh water trout on growing farms in 2015. The segment consists of four enterprises. The production volume was 30 tonnes with a corresponding income of €0.1 million.

Observing the structural development of primary trout farming enterprises in Figure 4.3.6, it can be seen that the share of trout combined segment increased in 2012. Reasons for that were the moving of a larger enterprise from the trout on growing segment to the trout combined segment, but also the addition of new companies.

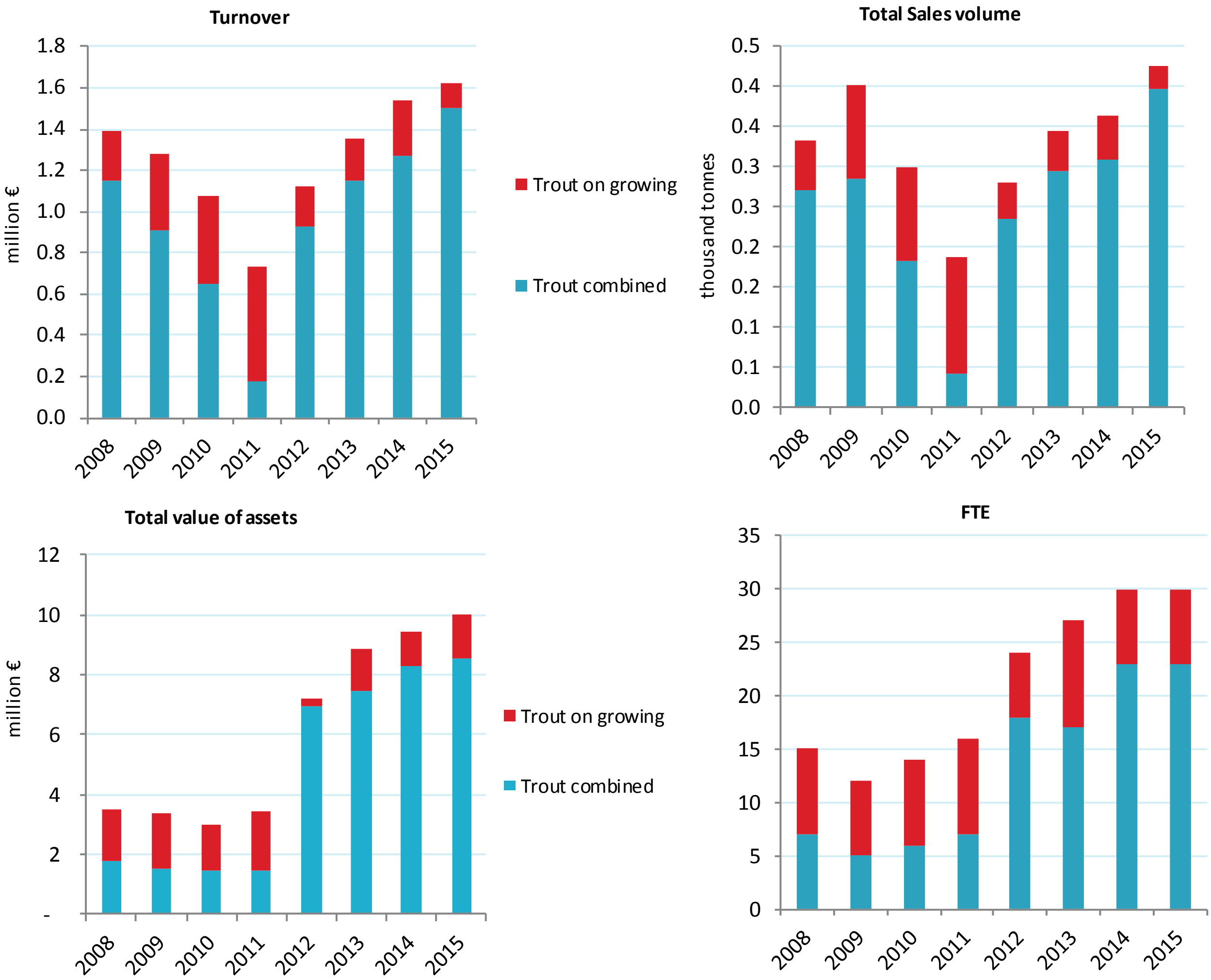


Figure 4.8.5 Structural development Estonian aquaculture sector: 2008-2015.
Source: EU Member States DCF data submission

The economic performance of the two Estonian segments is shown in Table 4.3.4 and Figure 4.3.7. It can be seen that the developments of the different variables are quite different. The economic performance of the trout combined segment was mainly affected by the heat wave in 2010. Both segments were also affected by the economic crisis and changes of enterprises in the segments.

Table 4.8.4 Economic performance of main Estonian aquaculture segments: 2008-2015 (in million €).

Variable	2008	2009	2010	2011	2012	2013	2014	2015	*% of total income*	Change 2015/14	Development 2015/(2008-14)
Trout combined											
Total income	*1.3*	*1.0*	*0.7*	*0.2*	*1.0*	*1.2*	*1.5*	*1.8*	*100%*	*20%*	*89%*
Gross Value Added	*0.6*	*0.4*	*0.1*	*-0.1*	*0.1*	*0.1*	*0.2*	*0.2*	*13%*	*19%*	*19%*
Operating cash flow	*0.5*	*0.3*	*0.1*	*-0.2*	*0.0*	*-0.2*	*-0.1*	*0.0*	*-1%*	*57%*	*-140%*
Earning before interest and tax	*0.5*	*0.3*	*0.0*	*-0.2*	*-0.2*	*-0.3*	*-0.2*	*-0.1*	*-8%*	*39%*	*-846%*
Net profit	*0.5*	*0.2*	*0.0*	*-0.2*	*-0.2*	*-0.4*	*-0.3*	*-0.3*	*-16%*	*17%*	*-306%*
Total sales volume (thousand tonnes)	*0.3*	*0.3*	*0.2*	*0.0*	*0.2*	*0.3*	*0.3*	*0.4*		*28%*	*71%*
Trout on growing											
Total income	*0.5*	*0.4*	*0.5*	*0.6*	*0.2*	*0.2*	*0.3*	*0.2*	*100%*	*-35%*	*-53%*
Gross Value Added	*0.1*	*0.1*	*0.1*	*0.2*	*0.0*	*-0.1*	*-0.1*	*-0.1*	*-32%*	*51%*	*-265%*
Operating cash flow	*0.1*	*0.0*	*0.0*	*0.1*	*-0.1*	*-0.2*	*-0.2*	*-0.1*	*-56%*	*46%*	*-185%*
Earning before interest and tax	*0.0*	*-0.1*	*-0.1*	*0.0*	*-0.1*	*-0.2*	*-0.2*	*-0.1*	*-78%*	*32%*	*-83%*
Net profit	*0.0*	*-0.1*	*-0.1*	*0.0*	*-0.1*	*-0.2*	*-0.2*	*-0.2*	*-107%*	*23%*	*-70%*
Total sales volume (thousand tonnes)	*0.1*	*0.1*	*0.1*	*0.1*	*0.0*	*0.0*	*0.1*	*0.0*		*-44%*	*-64%*

Source: EU Member States DCF data submission

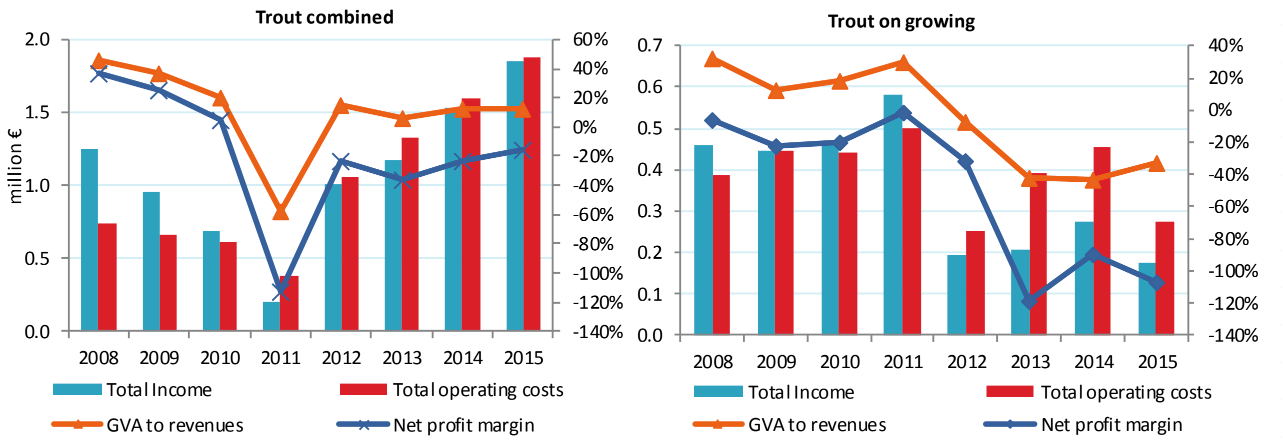


Figure 4.8.6 Economic performance indicators for the main Estonian segments: 2008-2015.
Source: EU Member States DCF data submission

In Figure 4.3.8, the operational cost structures for the two segments are presented:

Segment 1: Trout combined

The main cost components are feed costs (42%), other operational costs (26%), and costs of wages and salaries and energy costs (12% each).

Segment 2: Trout on growing

The shares of cost components are rather similar to previous segment. The feed costs are also the most important covering 26% of the total operational costs. However, the share of livestock costs (21%) is much higher.

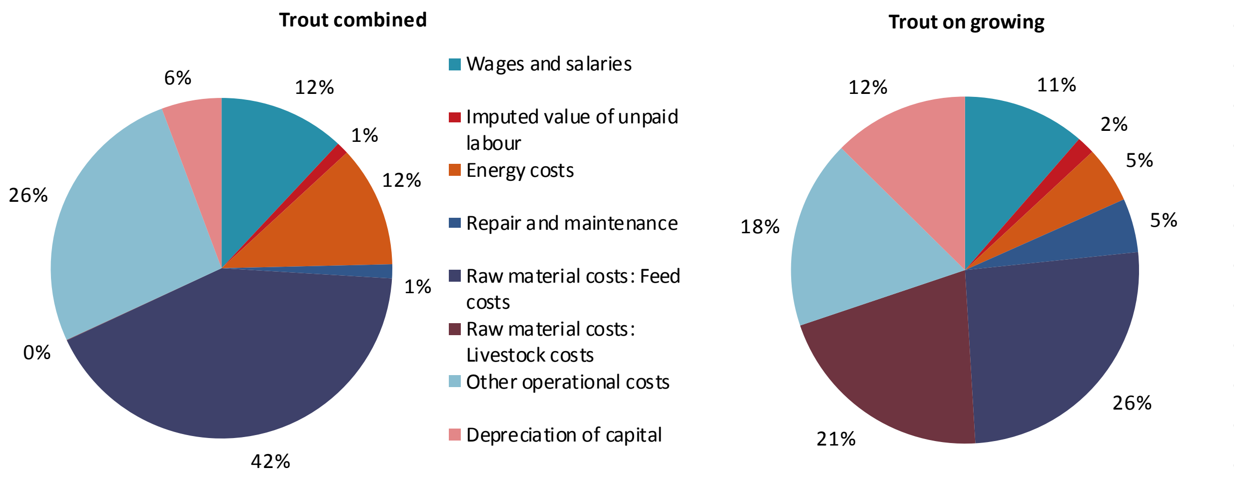


Figure 4.8.7 Cost structure of the main segments in Estonia: 2015.
Source: EU Member States DCF data submission

In Figure 4.8.8, the feed and livestock prices for the two segments are presented. Figures reveal that the price of feed has maintained its level through the years 2008-2015, but same time the price of livestock has increased.

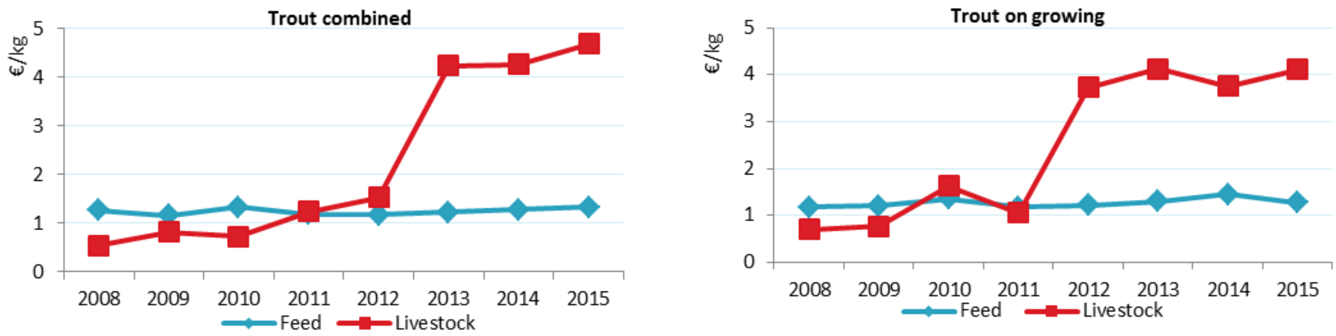


Figure 4.8.8 Feed and livestock prices for the main Estonian segments: 2008-2015.
Source: EU Member States DCF data submission

4.8.5 Trends and triggers

Current production trends and main drivers

Due to the small volume the rainbow trout are mainly marketed domestically. The production volume of primary trout farming sector has been greatly affected by weather conditions. The production of Estonian aquaculture sector decreased significantly in 2011. The reason for that was heat wave in 2010 which caused a great loss in rainbow trout production. Undoubtedly this event had an impact on production also in the following years. However, current data show that production volumes of the Estonian trout producers are recovering. In addition to already operating fish farms the growth in production from the new farms, which have been created with support from the European Fisheries Fund, is increasing. According to the data from Statistics Estonia the trout production increased 26% in 2017, compared to 2015.

Natural resources such as water and land do not limit development of fish farming in Estonia. However, the lack of investment capital and know-how has been the main factors restricting the development of fish farming in Estonia. The majority of Estonian fish farms are family owned and run, therefore success depends on the owner's knowledge and financial capacity. To some extent support from European Fisheries Fund (EFF) helped to solve the problem of investment capital. Around €13 million was allocated from EFF for the establishment and modernization of fish farms.

Market structure

Due to its small size, the aquaculture sector has little influence on the national economy in Estonia. Low production volumes cannot secure year-round supply for large supermarket chains or attract the interest of exporters. The relatively high production cost of red-flesh trout makes it difficult to compete with similar products imported from Norway. However, some fish farms have started to add value for products through processing and increasing the quality (filleting, salting, marinating, smoking) which can help to broaden the market and raise profitability. The rainbow trout and common carp are mainly marketed domestically. Eel production has increased and most is exported. Sturgeon production was affected by the restrictions imposed by the Russian Federation on the import of foodstuffs and the related reduction in marketing opportunities. Aquaculture has a little more influence on the economy through tourism, because they supply put-and-take ponds which are an attractive part of leisure time activities in many holiday houses. There are over 60 fishing tourism enterprises in Estonia that buy fish from fish farms and offer angling services in their ponds. Some enterprises are testing the cultivation of new fish species which may also expand marketing possibilities (e.g. African catfish, Arctic char, tilapia).

Issues of special interest

Currently, Estonian fish farmers have difficulties to compete with imported trout and salmon products in the domestic market. According to the aquaculture development strategy the areas to be addressed for production growth are:

- Strengthen the competitiveness through targeting investments to the technologies and solutions that improve efficiency and quality of production;
- The use of domestic market advantage;
- Aquaculture business collaboration and strategic partnerships;
- Development of value-added and differentiated products;
- Cultivation of species which are suitable for Estonian natural conditions and have high foreign demand (e.g. eel, sturgeons, whitefish, perch, pike-perch, crayfish);
- Development of a supportive business environment for the promotion of aquaculture;
- Specific knowledge and skills acquisition.

In the last years, companies have begun to invest in indoor fish farming (closed) aquaculture systems. Although these farms are energy consuming, they give the opportunity to grow and deliver production throughout the year and more environmentally friendly. Also they are no longer dependent on environmental conditions.

Outlook for future production trends

According to the Estonian multiannual national plan for the development of sustainable aquaculture the vision for 2020 is to build up a leading position in the domestic market of Estonia and become a successful exporter of species that suit local farming conditions and have a high demand in foreign markets (e.g. eel, sturgeons, whitefish, perch, pike-perch, crayfish). Priority is given to developing the competitiveness of already existing businesses and to investing in the expansion of companies which are successful on the market. The probable volume of the Estonian market for aquaculture products is estimated at 6500 tonnes in 2020. Thus, to achieve the vision, Estonian aquaculture production must reach more than 3000 tonnes of sales. This number is consistent with the investments are made in aquaculture sector.

4.8.6 Data Coverage and Data Quality

Due to the small number of commercial fish farming companies it was reasonable to collect data only concerning rainbow trout (enterprises whose primary activity was defined “Fish farming”); concerning other species the value of production was too small to justify any sampling activities. There was also a threat to confidentiality. That is a reason why DCF and EUROSTAT data may be different (Figure 4.8.9).

According to the multiannual Union programme for the collection, management and use of data in the fisheries and aquaculture sectors for the period 2017-2019, the collection of social, economic and environmental data on freshwater aquaculture is optional. Because there is no marine aquaculture and the total production of freshwater aquaculture is very low, Estonia does not collect data on aquaculture under the EU MAP.

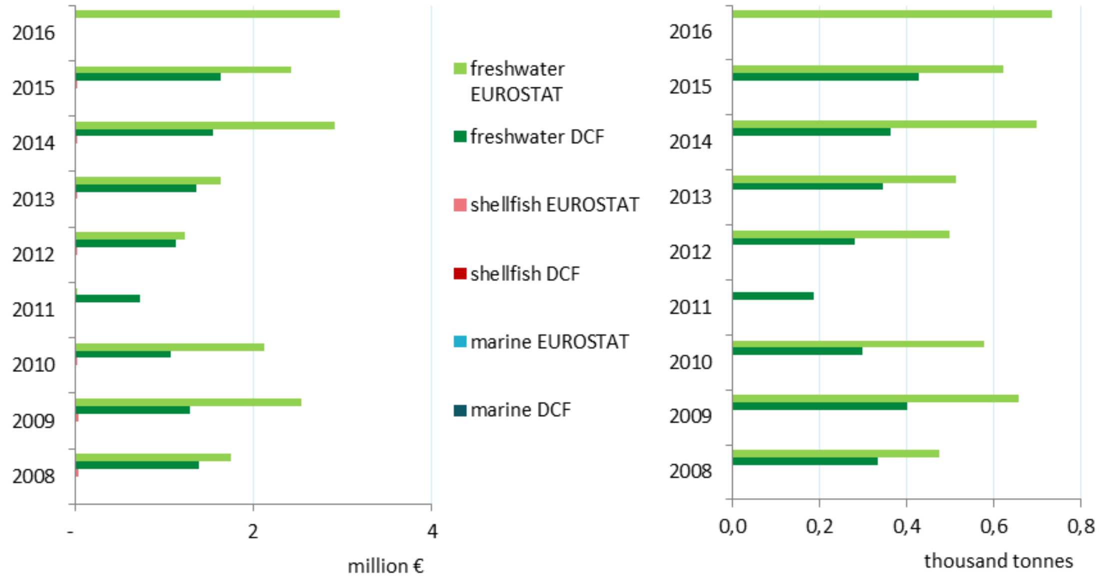


Figure 4.8.9 Comparison of DCF data with EUROSTAT data for Estonia: 2008-2015

4.9 Finland

4.9.1 Production and sales

The Finnish aquaculture sector produced 12 517 tonnes of fish and fry in 2016 with the total gross sales value of €63 million. Despite a decrease in the volume of marine production the revenue increased by 11% due to the improved prices. Rainbow trout prices are competing with imported Norwegian salmon: it has been proved that rainbow trout and imported salmon are fully integrated indicating that they are perfect substitutes in the Finnish salmonids markets. Therefore, the production problems in the major producing countries - Norway and Chile - together with increased demand has led to sharp increase in global salmon prices. And the price increase is transmitted fully to Finnish rainbow trout markets. This has increased the value of production and improved significantly the profitability of the Finnish marine aquaculture.

Table 4.9.1 Production and sales for Finland: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/(08-15)
Sales weight (thousand tonnes)	***11.2***	***8.1***	***10.1***	***9.9***	***11.1***	***11.4***	***11.7***	***13.0***	***12.5***	*-4%*	*16%*
Marine	6.0	2.1	5.5	4.9	4.3	4.3	5.2	9.5	9.0	*-5%*	*72%*
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		*0%*
Freshwater	4.7	5.4	3.9	4.4	6.3	6.6	5.8	1.5	1.4	*-7%*	*-71%*
Hatcheries & nurseries	0.5	0.7	0.7	0.7	0.5	0.6	0.7	2.0	2.1	*8%*	*166%*
Sales value (million €)	***50.0***	***55.1***	***56.6***	***53.4***	***53.6***	***63.2***	***59.7***	***61.1***	***62.7***	*3%*	*11%*
Marine	21.8	16.6	26.6	23.5	12.4	18.1	20.2	35.8	39.7	*11%*	*82%*
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		*0%*
Freshwater	19.6	27.8	19.7	18.3	32.3	36.9	33.0	9.6	10.4	*8%*	*-58%*
Hatcheries & nurseries	8.6	10.7	10.4	11.5	8.9	8.2	6.5	15.7	12.6	*-19%*	*25%*

*Structural break in time series due to the changed segmentation according to new regulation since 2015.
Source: EU Member States DCF data submission

The food fish production consisted mainly of rainbow trout. Almost 90% of the total food fish production value was generated by rainbow trout in 2016. European whitefish production is also important part of the Finnish food fish supply. European whitefish accounted for 9% of the production value in 2016. Together these two species accounted for 98% of total fish food farming in Finland.

The production of fry in fish farms consists mainly of rainbow trout fry for food fish farming. Fish farms produce also Baltic salmon, landlocked salmon, brown trout, sea trout, char and brook trout fry. Hatcheries and nurseries segment generated 26% of the total turnover of the sector in 2016.

The hatcheries and nurseries produced over 700 tonnes of fry for stocking and further rearing. The production of rainbow trout fry on fish farms was supplied almost exclusively for food fish farming. Fish farms also produced fry of Baltic salmon, landlocked salmon, sea trout, brown trout, char and brook trout.

4.9.2 Industry structure and employment

There were 173 main activity aquaculture companies in operation in Finland in 2016 with employment of 495 persons totalling 341 FTE. The number of aquaculture companies has been quite steady since 2009. Majority of the companies are micro-enterprises. In 2016 there were only 8 bigger companies employing more than 10 persons. In general, the sector is getting more and more concentrated: The ten biggest companies in the sector in terms of turnover made up over half of the total revenues in 2016.

Table 4.9.2 Structure of the Finnish aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/ (08-15)
Structure (number)											
Total enterprises	*180*	*160*	*163*	*163*	*164*	*165*	*170*	*176*	*173*	*-2%*	*3%*
<=5 employees	164	141	143	143	146	140	152	157	151	-4%	2%
6-10 employees	10	12	11	11	11	16	10	11	13	18%	13%
>10 employees	6	7	9	9	7	9	8	8	9	13%	14%
Employment (number)											
Total employees	*387*	*449*	*472*	*441*	*430*	*562*	*515*	*517*	*495*	*-4%*	*5%*
Male employees	296	337	359	339	317	421	387				
Female employees	91	112	113	102	113	141	129				
FTE	300	384	368	343	339	371	329	352	341	-3%	-2%
Male FTE	230	288	280	264	250	278	246				
Female FTE	70	96	88	79	89	93	82				
Indicators											
FTE per enterprise	1.7	2.4	2.3	2.1	2.1	2.3	1.9	2.0	2.0	-1%	-6%
Average wage (thousand €)	34.9	34.5	33.4	36.4	39.3	37.7	39.5	40.6	40.6	0%	10%
Labour productivity (thousand €)	53.4	48.6	53.1	48.2	40.5	40.1	50.5	48.5	57.8	19%	21%

Source: EU Member States DCF data submission

Employment of the aquaculture sector increased from 2008 but has decreased since 2013. In 2016 the sector employed 495 persons corresponding 341 FTE. On average, there are 2 FTEs employed per enterprise. The average annual wage per FTE was €40 600. The mean wage has been increasing from 2008 on.

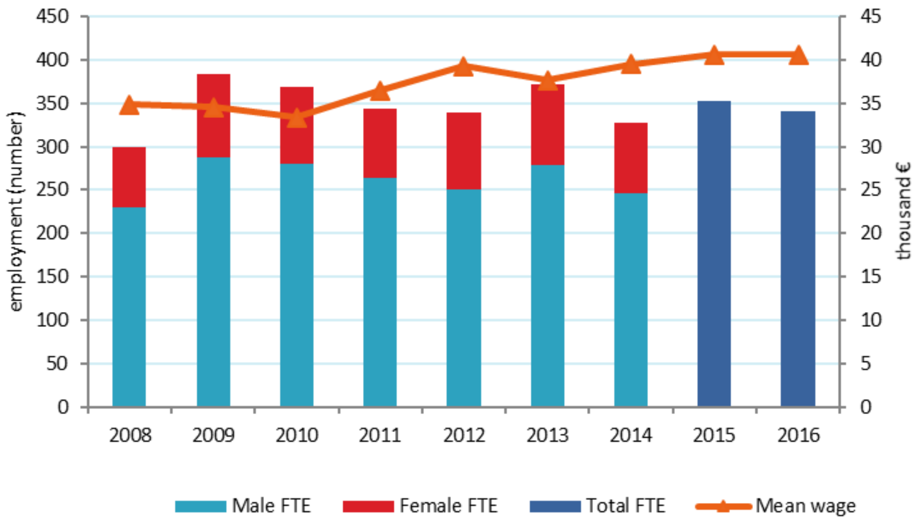


Figure.4.9.1 Employment trends for Finland: 2008-2016.
Source: EU Member States DCF data submission

The total income of the Finnish aquaculture sector has increased from 2008 to 2016. The annual price development of rainbow trout affects greatly on the total income. The increased prices in 2016 resulted the highest revenue in the period. Total operating costs follow the production and improved prices resulted in improved profitability. The labour productivity decreased from 2010 to 2013, but has increased since (Figure 4.9.2).

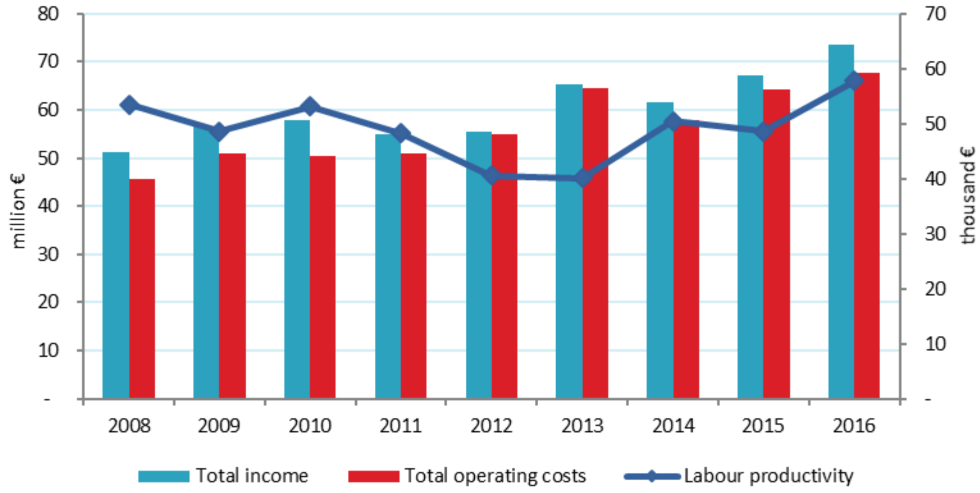


Figure 4.9.2 Income, costs, wages and labour productivity trends for Finland: 2008-2016.
Source: EU Member States DCF data submission

4.9.3 Economic performance

Since 2010, the economic performance of the Finnish aquaculture sector deteriorated and the sector ended up making losses. In 2016 the marked increase in prices together with increase in production improved the profitability of the sector significantly and the sector as whole was making profits.

In 2016 the total income of the sector was €74 million making profits of €2.5 million before interest and taxes (EBIT); net profit reached €1.5 million (Table 4.9.2). The total operating costs were 92% of the total income adding up to €68 million in 2016. The operating costs were dominated by cost of feed (38%) and wages and salaries (19%).

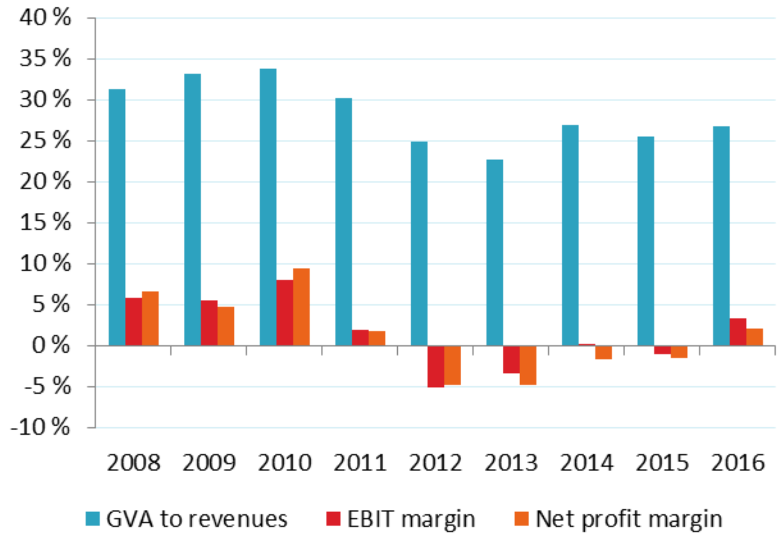


Figure 4.9.3 Economic performance for Finland: 2008-2016
Source: EU Member States DCF data submission

Table 4.9.3 Economic performance of the Finnish aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	% of total income	Change 2016-15	Development 2016/(2008-15)
Income (million €)												
Turnover	50.0	55.1	56.6	53.4	53.6	63.2	59.7	64.9	69.6	94%	7%	22%
Other income	1.3	1.3	1.2	1.6	1.8	2.1	1.9	2.1	4.1	6%	90%	146%
Subsidies	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0%	-13%	-68%
Total income	*51.3*	*56.4*	*57.8*	*55.0*	*55.4*	*65.3*	*61.6*	*67.0*	*73.7*	100%	10%	25%
Expenditures (million €)												
Wages and salaries	9.1	11.6	11.3	10.8	11.7	12.5	11.5	13.0	12.9	18%	0%	13%
Imputed value of unpaid labour	1.3	1.6	1.0	1.7	1.6	1.5	1.5	1.3	0.9	1%	-29%	-36%
Energy costs	1.3	1.4	1.5	1.5	1.6	1.9	3.3	3.8	4.2	6%	9%	103%
Repair and maintenance	1.7	1.8	1.8	1.9	2.0	2.4	2.3	2.0	2.3	3%	15%	15%
Raw material: Feed costs	19.5	20.9	21.2	21.3	23.1	28.0	23.7	24.4	25.5	35%	4%	12%
Raw material: Livestock costs	5.0	5.3	5.4	5.4	5.9	7.1	10.6	11.4	8.9	12%	-22%	27%
Other operational costs	7.7	8.2	8.3	8.4	9.1	11.0	5.1	8.3	13.1	18%	57%	59%
Total operating costs	*45.7*	*51.0*	*50.5*	*50.9*	*54.9*	*64.4*	*58.0*	*64.2*	*67.8*	92%	6%	23%
Capital Costs (million €)												
Depreciation of capital	2.6	2.3	2.7	3.0	3.4	3.2	3.5	3.5	3.4	5%	-3%	11%
Financial costs, net	-0.4	0.4	-0.9	0.1	-0.2	0.8	1.2	0.3	1.0	1%	204%	460%
Extraordinary costs, net	-0.5	0.0	-2.7	-0.7	-1.7	-0.5	-0.9					
Capital Value (million €)												
Total value of assets	68.3	58.3	90.8	94.9	99.3	104.3	95.7	94.4	117.0	159%	24%	33%
Net Investments	-1.8	-1.9	2.1	9.6	-6.5	-1.6	-1.7	1.8	2.2	3%	18%	70307%
Debt	37.7	26.7	41.8	54.6	59.6	70.3	64.3	57.4	84.2	114%	47%	63%
Input & Production (thousand tonnes)												
Raw material: Feed	15.3	14.2	13.8	18.0	14.3	14.7	13.8	13.0	11.2		-13%	-23%
Raw material: Livestock	0.6	0.6	0.7	0.9	0.8	0.8	0.9	0.8	0.7		-10%	-10%
Performance Indicators(million €)												
Gross Value Added	16.0	18.7	19.6	16.5	13.7	14.9	16.6	17.1	19.7	27%	15%	18%
Operating cash flow	5.6	5.4	7.3	4.1	0.5	0.9	3.7	2.8	5.9	8%	109%	55%
Earning before interest and tax	3.0	3.1	4.6	1.1	-2.8	-2.2	0.1	-0.7	2.5	3%	470%	224%
Net profit	3.4	2.7	5.5	0.9	-2.7	-3.1	-1.1	-1.0	1.5	2%	247%	152%
Capital productivity (%)	23.5	32.0	21.5	17.4	13.8	14.3	17.4	18.1	16.8		-7%	-15%
Return on Investment (%)	4.4	5.4	5.1	1.1	-2.9	-2.2	0.1	-0.7	2.1		398%	65%
Future Expectation Indicator (%)	-6.4	-7.3	-0.7	6.9	-9.9	-4.6	-5.5	-1.8	-1.0		41%	72%

Source: EU Member States DCF data submission

The gross value added and profitability of the sector declined from 2010 until 2013 when the sector was making over €3 million losses. Since then profitability of the sector improved significantly due to increase in prices. In 2016 the gross value added reached €20 million and the sector turned profitable making net profits of €1.5 million.

4.9.4 Main species produced and economic performance by segment

Finnish aquaculture sector is divided in new EUMAP regulation into 5 segments:

- Segment 1: Trout cages;
- Segment 2: Trout Tanks and race-ways;
- Segment 3: Trout Recirculation systems;
- Segment 4: Trout Hatcheries & nurseries;
- Segment 5: Other freshwater fish Ponds;

The most important farming method is the trout cage farming that covers marine rainbow trout and European whitefish production. Two other trout production methods are inland food fish production in Tanks and raceways and Recirculation systems. Hatcheries and nurseries segment include also farms that have rainbow trout production. The last and least segment is the natural ponds that produce freshwater juveniles for restocking.

In previous segmentation according to DCF there was a segment of combined production of juveniles and food fish that was the biggest segment of the sector. These companies are now for 2015 onwards allocated according to EUMAP based on main type of production. This has increased significantly the production and revenue of the Trout cage production and Hatcheries and nurseries segments compared to the results based on previous segmentation for 2008-2014.

The food fish production consisted mainly of rainbow trout. Almost 90% of the total food fish production value and over 90% of the production volume was generated by rainbow trout in 2016. European whitefish production is also important part of the Finnish food fish supply. European whitefish accounted for 9% of the production value and 5% of the total food production volume in 2016.

The production of fry in fish farms consists mainly of rainbow trout fry for food fish farming. Fish farms produce also Baltic salmon, landlocked salmon, brown trout, sea trout, char and brook trout fry. Hatcheries and nurseries segment generated 26% of the total turnover of the sector in 2016.

Figure 4.9.4 Main species in terms of weight and value in the Finnish aquaculture production: 2014.
Source: EU Member States DCF data submission

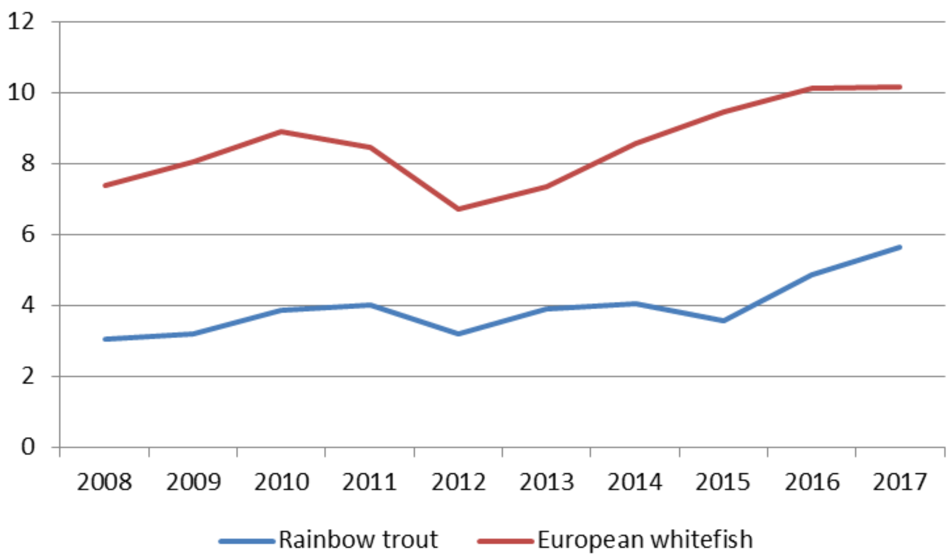


Figure 4.9.5 Average prices for the main farmed food fish species in Finland: 2008-2017.
Source: Source: OSF: Natural Resources Institute Finland, Aquaculture.

Figure 4.9.5 presents the price development of the two main food fish species, rainbow trout and European whitefish. From 2015 the nominal price of rainbow trout has increased 57% due to the sharp increase in global salmon prices. Farmed European whitefish price has increased steadily since 2012.

The figure 4.9.6 presents the development of structure of the sector from 2008. In 2016 the trout cage farming accounted for more than half of the total turnover and three quarters of the total sales volume followed by hatcheries and nurseries.

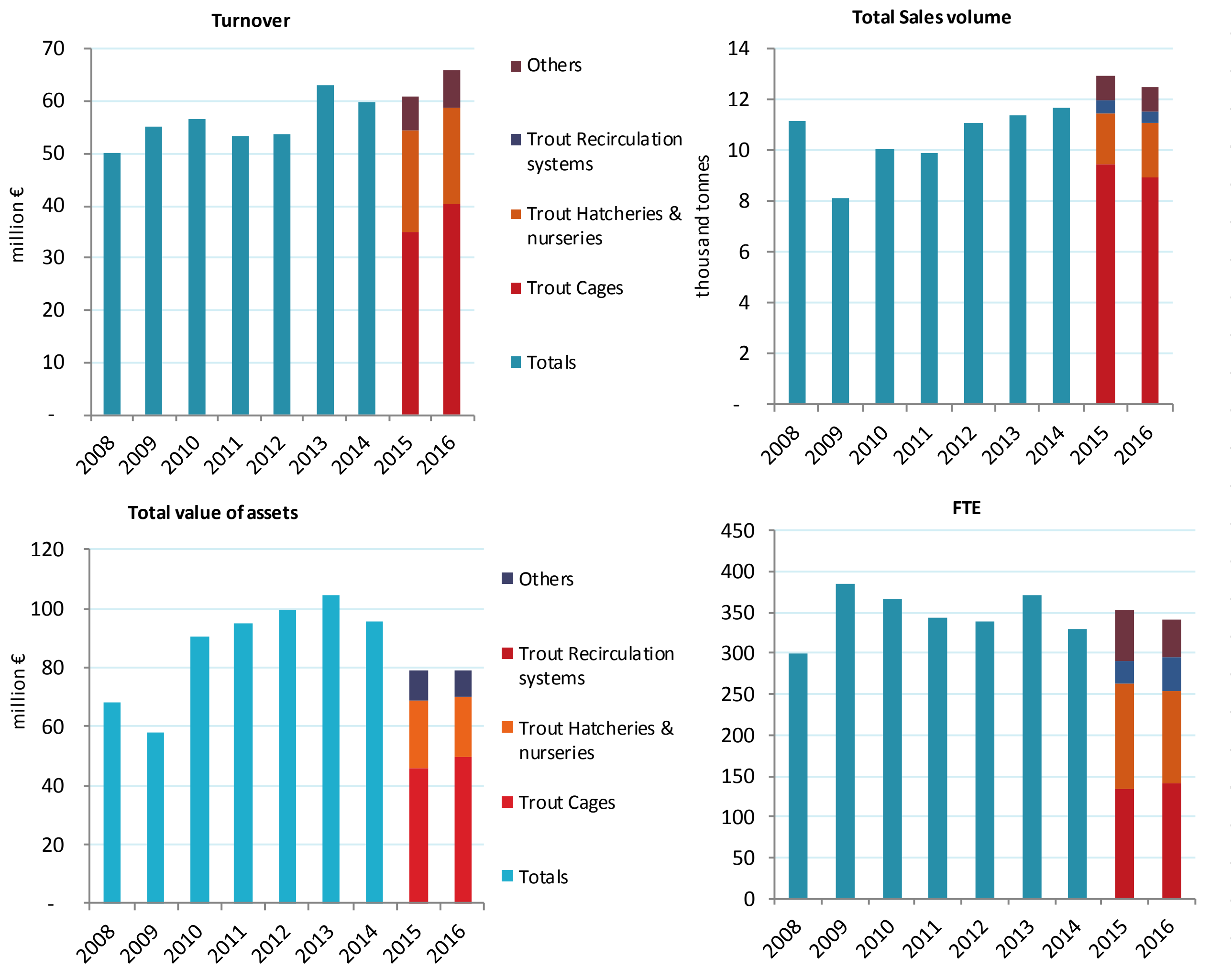


Figure 4.9.6 Structural development Finnish aquaculture sector: 2008-2016.
Source: EU Member States DCF data submission

Investments in expansion of RAS production are reflected in increase in value of assets in the sector. These investments account for the total increase total asset value of the sector. The net investments in trout cage farming and inland tank and race-way farming offset the decrease in other hatcheries and natural ponds segments. The expansion of RAS production is also shown in increase in employment while there was decrease in labour input in Natural ponds segment.

Table 4.9.4 Economic performance of main Finnish Bulgarianaquaculture segments: 2008-2014 (in million €).

Variable	2015	2016	% of total income	Change 2016/15
Trout Cages				
Total income	35.9	42.7	100%	19%
Gross Value Added	7.3	12.4	29%	70%
Operating cash flow	2.2	7.4	17%	231%
Earning before interest and tax	0.7	5.9	14%	773%
Net profit	0.2	5.4	13%	3274%
Total sales volume (thousand tonnes)	9.5	9.0		-5%
Trout Recirculation systems				
Total income	4.0	4.6	100%	15%
Gross Value Added	0.1	-1.2	-27%	-1151%
Operating cash flow	-1.2	-3.2	-70%	-175%
Earning before interest and tax	-2.0	-4.0	-88%	-98%
Net profit	-2.4	-4.8	-105%	-96%
Total sales volume (thousand tonnes)	0.5	0.4		-17%
Trout Hatcheries & nurseries				
Total income	20.4	19.1	100%	-6%
Gross Value Added	7.6	6.8	36%	-10%
Operating cash flow	1.9	1.9	10%	-3%
Earning before interest and tax	1.2	1.2	7%	2%
Net profit	1.4	1.5	8%	11%
Total sales volume (thousand tonnes)	2.0	2.1		8%

Source: EU Member States DCF data submission

Segment 1: Trout cage production

The most important segment in terms of total income was marine production of rainbow trout and European whitefish in cages with gross sales value of €42.6 million in 2016; due to the marked increase in prices the total revenue increased 19% even with a slight decline in production volume. In 2016 the production consisted mostly of rainbow trout (8.7 thousand tonnes), but also 323 tonnes of European whitefish were produced.

Due to the price increase the profitability of segment increased significantly. The gross value added of the segment almost doubled to €12.4 million from the previous year and the segment made a net profit of €5.4 million in 2014.

Segment 2: Trout tanks and race-ways

Trout tanks and race-ways are traditional inland aquaculture production methods. In 2016 the segment produced 831 tonnes of rainbow trout and 78 tonnes of European whitefish. Despite the total weight of sales declined slightly from the previous year the gross sales value increased by 15% to €4.7 million due to the marked increase in prices. Despite this positive effect the profitability decreased due to the increase in costs. The Gross value added almost halved and the segment was making losses.

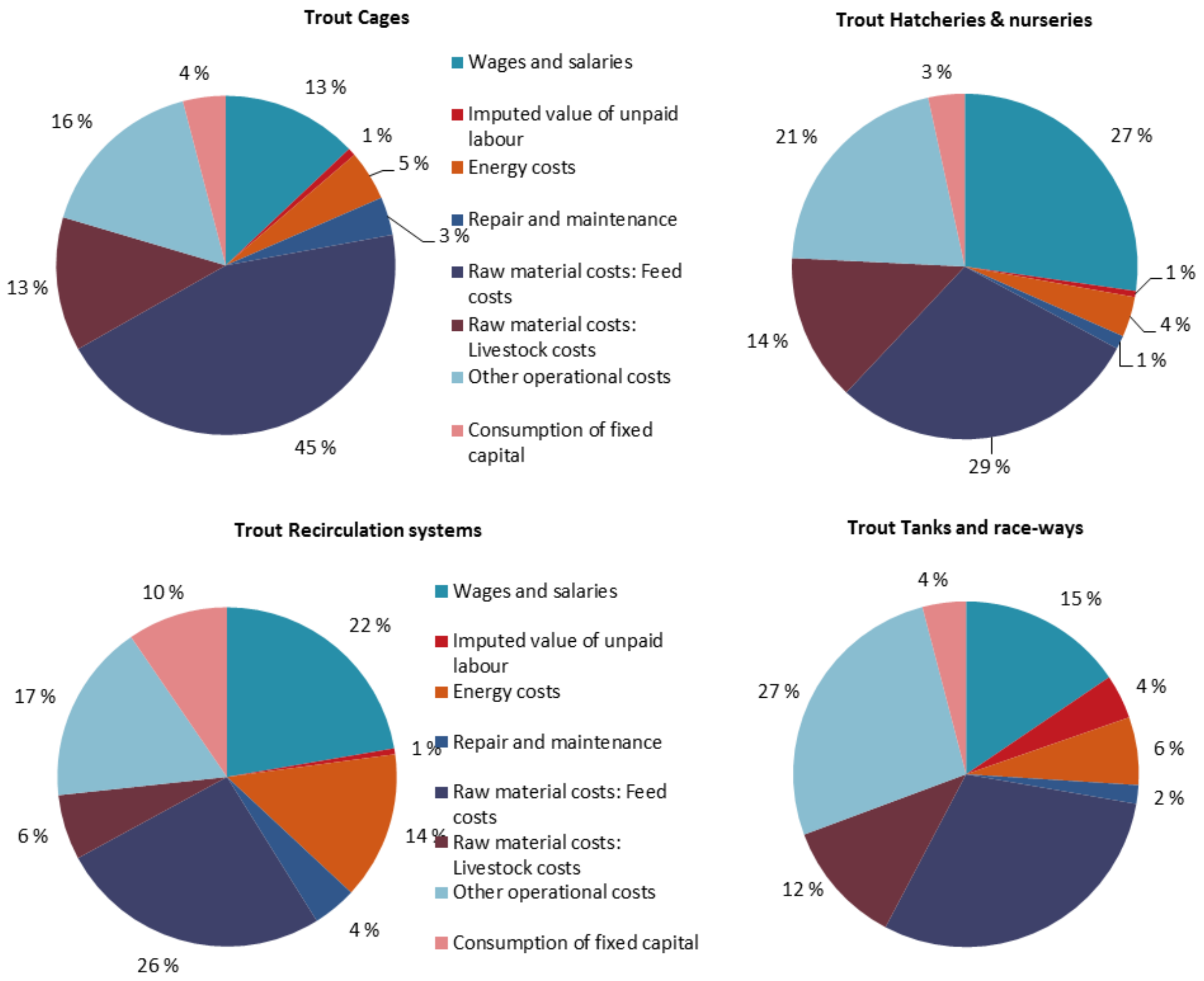


Figure 4.9.7 Cost structure of the main segments in Finland: 2016.
Source: EU Member States DCF data submission

Segment 3: Recirculation systems

Recirculating aquaculture systems have become more common in Finland in the recent years. The recirculating systems have a great potential as the nutrient load can be easily managed while it is possible to maintain optimal culturing conditions all year round.

Therefore, RAS production has been the only production system that has received new production licenses recent years. Number of recirculating systems units have increasing in the recent years. There were 7 recirculating systems units in operation in 2016 producing 400 tonnes of fish with a gross sales value of €3.6 million.

However, high investment and production costs as well as risks related to introducing new technologies impose challenges for this technology and the segment is making losses. Despite an increase in total income in 2016 the profitability decreased significantly. The poor profitability has already forced a couple of companies to close down their production for financial reasons.

Segment 4: Trout Hatcheries & nurseries

The total income of hatcheries and nurseries of other fresh water fish was €19.1 million in 2016 with a decline of 6% from the previous year. The production of fry in fish farms consists mainly of rainbow trout fry for food fish farming. Fish farms also produce Baltic salmon, landlocked salmon, brown trout, sea trout, char and brook trout fry. In this segment there are also enterprises with combined production of food fish. Despite a drop in gross value added the segment profitability increased and the net profit was €1.5 million.

The cost structures for the four Finnish aquaculture segments are presented in the Figure 7. Feed costs are the largest cost item in all segments. Trout cages segment has relatively highest feed costs accounting for 45% of total costs. The segment seems less labour intensive than the others as the wages and salaries make up only 14% of the total operating costs.

Hatcheries and nurseries that do not have combined food fish production have different cost structure from the other segments. However, in the current segmentation with combined food fish production included the difference is not that significant compared to that in former segmentation.

The main cost items for inland food fish producers (RAS and Tanks and race-ways) are the feed cost, wages and salaries and livestock costs. RAS production is by far most energy intensive with 14% cost share.

4.9.5 Trends and triggers

Current production trends and main drivers

The Finnish aquaculture sector has been strongly affected by the environmental permit policy. Aquaculture producers need to have an environmental permit in order to operate in the aquaculture sector. The main reason for introducing the environmental permit mechanism has been the limiting nutrient loadings in the Baltic Sea.

The restrictive environmental policy has restrained the intensifying the Finnish aquaculture production and consequently the sector has not been able to benefit from the economies of scale. Due to the tight environmental permit policy, some of the Finnish aquaculture producers have moved their production to Sweden where the environmental regulation is more favourable for the aquaculture production. Annually some 10 thousand tonnes of rainbow trout are imported from Sweden to Finland.

The Finnish government, in cooperation with the research institutes and the aquaculture industry, are working together in combining the interests of the industry with environmental goals and developing a new environmental permit system which would allow increasing Finnish aquaculture production environmentally friendly. The administration of national environmental control system is being reorganized in order to make the system more predictable to attract more investments in the sector.

Finland has a National spatial planning program that aims to concentrate the aquaculture production in marine areas into bigger production units and to direct the production in areas where the use of marine areas can be optimally accommodated. Nowadays the nutrient load of aquaculture production per tonne of fish produced is only one third of what it was in the 1980s. This reduction has been possible thanks to fish feed development, developing new culturing techniques and selective breeding of fish. Transferring marine aquaculture production in big production units further offshore to the open sea has potential for increasing the production.

Recirculating aquaculture systems have become more common in Finland in the recent years. The recirculating systems have a great potential as the nutrient load can be easily managed while it is possible to maintain optimal culturing conditions all year round. However, high production costs as well as risks related to introducing new technologies impose challenges for this technology. Already a couple of production units have been forced to close their production for financial reasons. However, one of the biggest recirculating systems units in the world started to operate in 2016 in province of Åland Islands.

Market structure

The Finnish aquaculture sector has been increasingly concentrated. The ten biggest companies in the sector in terms of turnover made up over half of the total revenues in 2016. The competitiveness and performance of the sector is mostly connected to the price developments of fish, mainly rainbow trout and salmon, but also developments of the feed cost play an important role.

Almost all aquaculture production in Finland is consumed in the domestic market. However, in 2016 the exports of rainbow trout increased on third to 3.6 million kilos. Aquaculture imports consist mostly of Norwegian salmon and Swedish rainbow trout. Imports of aquaculture product account for about 40% of the total fish consumption in Finland.

Issues of special interest

Finland has a national spatial planning program of aquaculture which takes into account the different uses of marine areas in order to direct the aquaculture production into areas where it is suitable for both the environment and the aquaculture industry. In this way, the environmental effects can be minimized together with creating possibilities for production growth and improving the profitability of the sector. Spatial planning plans were incorporated in the multiannual national plan for the development of sustainable aquaculture.

Another potential for increasing the production environmentally friendly is using Baltic Sea fish feed for nutrient neutral aquaculture production. In 2016 a new fishmeal plant started producing Baltic Sea fish feed. The idea is that the nutrients of the Baltic Sea are recycled by using Baltic Sea fish feed made of Baltic herring for aquaculture production. This creates an opportunity for nutrient neutral growth fish farming. The plant was built with EMFF support.

Most recent investments have been made into recirculating aquaculture systems. However, the potential production capacity of recirculating aquaculture systems has not yet been fully fulfilled and there is an ongoing process of research and development of new aquaculture techniques for Northern environments as well as continued testing for new species (eg. different applications of recirculating aquaculture systems). Also new industrial symbiosis has been developed, where aquaculture production makes use of other industrial production processes and vice versa.

Outlook for 2015 and 2016

The total Finnish food fish production was 14 400 tonnes with value of €57 million in 2016. Despite a slight decrease in volume the value of the production increased marked 29% due to the increased price together with global salmon price. These figures include all aquaculture fish production for human consumption in Finland, not only the production of the main activity companies. In addition to food fish, aquaculture sector produced fry totalling 50 million individuals of different ages, both for stocking and further rearing.

Finland has set the national strategy for aquaculture for the period of 2014 to 2020. In the strategy, the objective is to increase production volume from 13 700 tonnes in 2014 to 20 000 tonnes in 2020 (46% increase). Furthermore, Finland wants to increase the production value from €60 million to €100 million in 2020 (67% increase). One of the objectives is to lighten the administrative burden caused by the environmental permit system and related procedures. The permit system will be developed to be straightforward yet not compromise the level of environmental protection provided.

A multiannual innovation and development programme is being promoted to support the growth of sustainable aquaculture, which will be put into practice following the principles of learning and network-based development. A network of technical expertise and innovation in aquaculture is being built, within which the sector can develop to a high international standard, facilitated by multi-stakeholder cooperation. Finland aims to develop strong PPP–models and platforms to research and industry.

Finland has adopted an aquaculture spatial plan that identifies the most suitable and productive areas for aquaculture production in marine areas. This plan will be integrated into the national marine spatial plan, and will be supported by the permitting system.

Finland is expecting to increase the aquaculture production in the future by developing further the environmentally friendly aquaculture techniques such as recirculating systems, recycling nutrients by using Baltic Sea fish feed for aquaculture, moving some of the aquaculture production offshore to bigger production units and improving national spatial planning.

4.9.6 Data Coverage and Data Quality

Data quality

Economic EU data collection of aquaculture sector in Finland combines information from different data sources. Main sources are a production survey of Natural Resource Institute (Luke), structural business and financial statement statistics of Statistic Finland (SF) and account survey conducted by Natural Resource Institute. Financial statements were available for all firms in Business Register having aquaculture as the main activity.

Primary sources of financial statements data in Statistics Finland are direct inquiries and business taxation material supplemented by Business Register data. Data is based on corporate balance sheets and profit and loss account data. Statistics Finland checks for the validity of the data. Any missing data was estimated within stratum. Account data was surveyed by Natural Resource Institute by stratified survey to detect the detailed cost structure of fish farms. Cost and earnings estimates were done by design-based and model assisted regression and ratio estimation. The cost variables were estimated with ratio estimation from financial statements. A production survey was collected exhaustively from the producers. Any missing information was estimated by stratum.

Data availability

The reference year of economic data collection is the preceding year. Preliminary financial statements data from Statistics Finland are available on the 4th quarter after the reference year. Data on production volume and value is available half a year after the reference year. Therefore, information of the economic situation of aquaculture sector is provided earliest one year after the period investigated.

Confidentiality

Natural Resource Institute does not provide or publish any information about the financial statements or key indicators of individual companies. When segmentation is used to split data into smaller groups, each segment includes at least five companies. If there are less than five companies in a segment, they are clustered with other segments.

Differences in DCF data compared with other official data sources

Natural Resources Institute Finland provides the data on aquaculture for Eurostat and the DCF and thus the differences in the Figure 4.9.6 are due to different estimation and classification practices of these organizations and different data needs. Eurostat data include all aquaculture production in Finland, including also production of companies that are not main activity producers whereas DCF data includes only those companies that have aquaculture as their main business activity. In addition, Eurostat data include only food fish production and no juvenile or fry production. Both fish produced for human consumption and fry are included in the DCF data.

European whitefish production in cages is reported as fresh water production in the Eurostat data, but it is reported as marine production in the DCF data. There was some shellfish production reported to Eurostat in 2013 and 2014, but no shellfish was reported under DCF as there was not enough economic data available for shellfish farmers. In Figure 4.9.6, the DCF data of production value is based on the turnover of aquaculture companies instead of the sales value of cultured fish and fry. The turnover can include other business activities and is not limited to the pure sales of aquaculture products produced by the company.

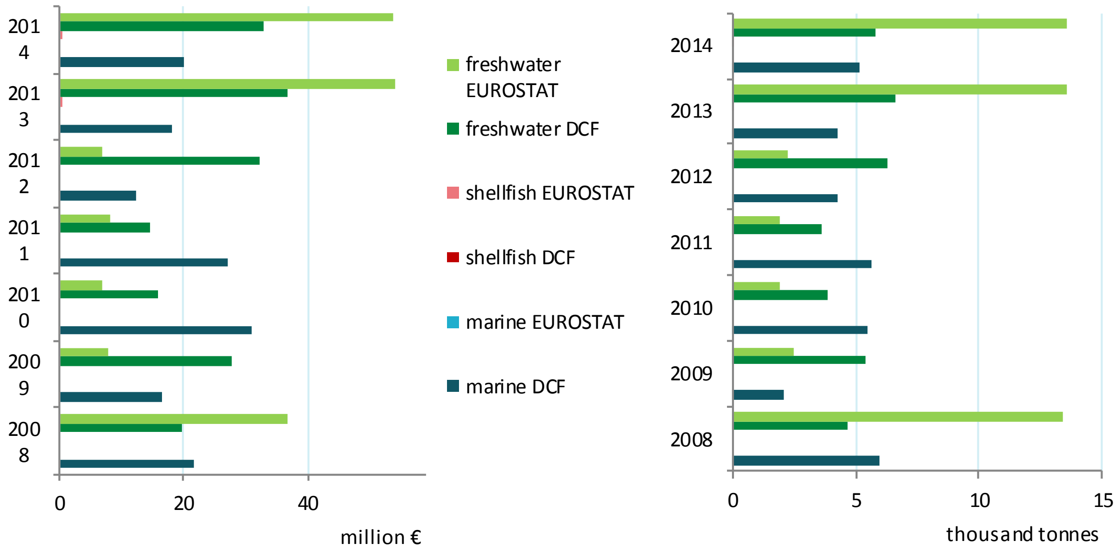


Figure 4.9.6 Comparison of DCF data with EUROSTAT data for Finland: 2008-2014

4.10 France

4.10.1 Production and sales

The total output of the French aquaculture sector in 2016 is 219.7 thousand tonnes and €765.2 million as turnover. The sales volume decreased by 10% in comparison with the average of 2010-2015 but turnover is stable. The diminution in weight was observed in all sectors. It's the same for sales value.

Table 4.10.1 Production and sales for France: 2010-2016.

Variable	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/(08-15)
Sales weight (thousand tonnes)	***287.8***	***257.6***	***246.1***	***227.6***	***222.9***	***226.6***	***219.7***	*-3%*	*-10%*
Marine	0.0	0.0	0.0	0.0					
Shellfish	247.3	221.5	212.8	193.1	191.5	198.8	191.8	*-4%*	*-9%*
Freshwater	40.4	36.1	33.3	34.5	31.4	27.8	27.8	*0%*	*-18%*
Hatcheries & nurseries	0.0	0.0	0.0	0.0					
Sales value (million €)	***792.7***	***800.8***	***875.9***	***826.4***	***831.2***	***765.4***	***765.2***	*0%*	*-6%*
Marine	0.0	0.0	0.0	0.0					
Shellfish	670.2	680.9	770.0	713.3	720.8	656.7	656.5	*0%*	*-6%*
Freshwater	122.5	119.9	105.9	113.1	110.4	108.7	108.7	*0%*	*-4%*
Hatcheries & nurseries	0.0	0.0	0.0	0.0					

Source: EU Member States DCF data submission

4.10.2 Industry structure and employment

From 2010 to 2016, the number of enterprises decreased from 3 171 to 2 700. Employment in the French aquaculture sector reach 15 074 persons for 8 837 full time equivalent jobs (FTE), table 4.10.2.

Table 4.10.2 Structure of the French aquaculture sector: 2010-2016.

Variable	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/(08-15)
Structure (number)									
Total enterprises	*3,171*	*3,125*	*3,104*	*2,988*	*2,935*	*2,797*	*2,700*	*-3%*	*-11%*
<=5 employees	2,403	2,429	2,402	2,215	2,232	2,117	2,053	*-3%*	*-11%*
6-10 employees	425	387	381	456	407	410	388	*-5%*	*-6%*
>10 employees	343	309	321	317	296	270	259	*-4%*	*-16%*
Employment (number)									
Total employees	*18,519*	*17,311*	*17,363*	*17,922*	*16,492*	*15,518*	*15,074*	*-3%*	*-12%*
Male employees	11,938	11,279	11,385	11,648	10,994	10,605	10,376	*-2%*	*-8%*
Female employees	6,581	6,032	5,978	6,274	5,498	4,913	4,698	*-4%*	*-20%*
FTE	10,139	9,677	9,646	8,905	9,060	9,027	8,837	*-2%*	*-6%*
Male FTE	7,299	7,020	6,989	6,471	6,622	6,724	6,591	*-2%*	*-4%*
Female FTE	2,841	2,656	2,657	2,434	2,438	2,303	2,246	*-2%*	*-12%*
Indicators									
FTE per enterprise	3.2	3.1	3.1	3.0	3.1	3.2	3.3	*1%*	*5%*
Average wage (thousand €)	23.2	24.6	23.6	27.2	28.5	24.2	25.1	*4%*	*-1%*
Labour productivity (thousand €)	44.0	39.9	49.3	53.2	52.0	45.7	47.7	*4%*	*1%*

Source: EU Member States DCF data submission

The shellfish sector account for 2 432 companies (90% of the national total), mainly small scale and family structures (69%). They employ around 13 841 jobs representing 7 892 full time equivalent jobs (FTE) as seasonal jobs are quite important. During the latest years, the number of companies was decreasing slightly but this sector had 3 750 enterprises in 2002. In addition, if the tasks in the leaseholds are carried out by the majority of men, the work in the establishment (packaging, orders, billing, etc.) is rather feminine. On the period 2010-2016, the reduction of mal FTE is less important than female FTE. To cope with oyster mortalities, the manpower needs related to production activities (spat collection in particular) was more important. In contrast, the reduction in volumes sold resulted in a reduced need of women's work (oyster packing, direct sales).

The number of freshwater fish farming companies is 268 in 2016, 75% being small scale or family structures; the employment account for 1 233 jobs, corresponding to 945 FTE.

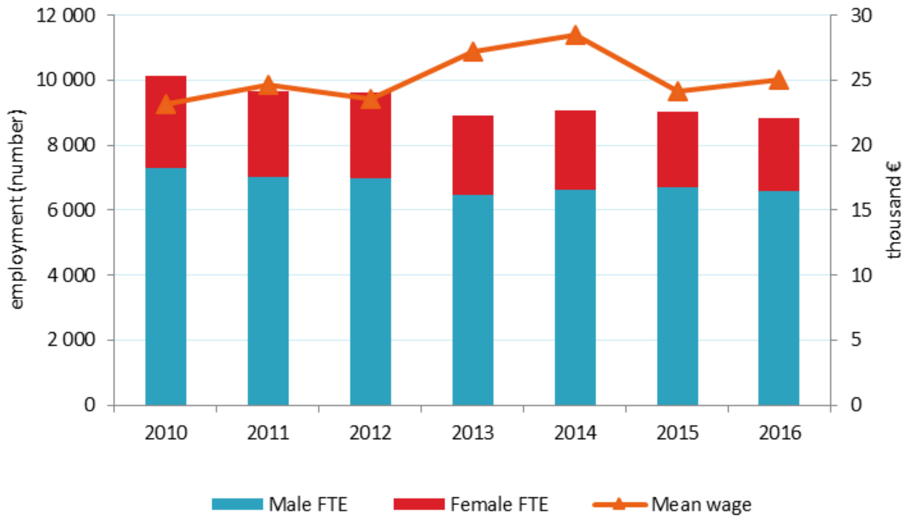


Figure 4.10.1 Employment trends for France: 2010-2016.
Source: EU Member States DCF data submission

Average wage and the labour productivity increase by 4% in 2016 compared to 2015. In comparison with the average of 2010-2015, the decrease of unpaid labour per FTE reaches 11%.

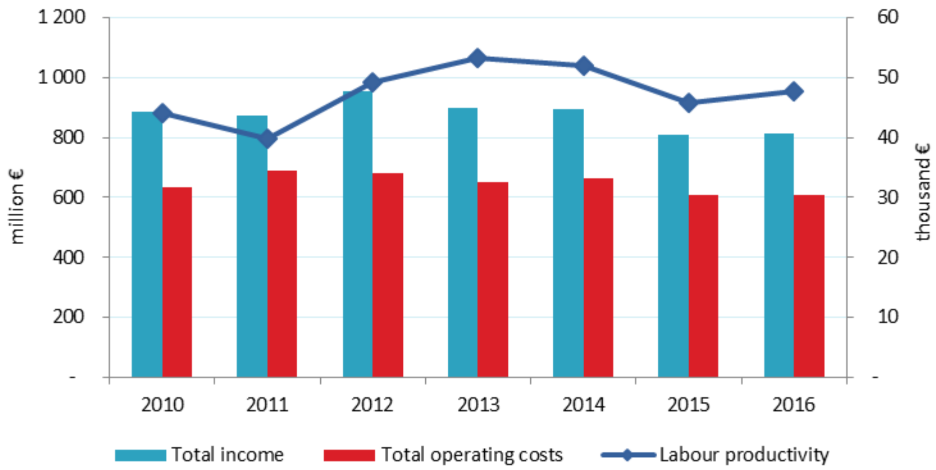


Figure 4.10.2 Income, costs, wages and labour productivity trends for France: 2010-2016.
Source: EU Member States DCF data submission

4.10.3 Economic performance

For the 6 segments where all economic indicators are available, the weight of shellfish farming sector (83% of the total turnover) influences widely the result of national economic performance. So, an average indicator can hide a disparity between different segments.

Table 4.10.3 Economic performance of the French aquaculture sector: 2010-2016.

Variable	2010	2011	2012	2013	2014	2015	2016	*% of total income*	Change 2016-15	Development 2016/(2008-15)
Income (million €)										
Turnover	792.7	800.8	875.9	826.4	831.2	765.4	765.2	*94%*	*0%*	*-6%*
Other income	50.2	36.7	50.5	55.8	47.1	37.4	44.3	*5%*	*18%*	*-4%*
Subsidies	45.0	35.1	27.9	17.6	16.5	6.4	5.9	*1%*	*-8%*	*-76%*
Total income	*887.8*	*872.5*	*954.3*	*899.8*	*894.9*	*809.3*	*815.4*	*100%*	*1%*	*-8%*
Expenditures (million €)										
Wages and salaries	133.1	126.9	126.0	127.0	137.0	119.8	125.4	*15%*	*5%*	*-2%*
Imputed value of unpaid labour	102.2	111.4	101.8	115.3	121.6	98.6	96.1	*12%*	*-3%*	*-11%*
Energy costs	22.0	24.2	26.6	26.5	27.4	24.8	22.4	*3%*	*-10%*	*-11%*
Repair and maintenance	25.9	24.7	23.9	22.8	23.9	22.0	23.5	*3%*	*7%*	*-2%*
Raw material: Feed costs	51.3	61.9	56.8	41.8	43.9	41.9	42.4	*5%*	*1%*	*-14%*
Raw material: Livestock costs	203.0	214.5	215.2	181.8	227.2	178.6	164.5	*20%*	*-8%*	*-19%*
Other operational costs	94.6	126.4	128.8	135.5	84.5	123.1	135.6	*17%*	*10%*	*17%*
Total operating costs	*632.1*	*690.1*	*679.0*	*650.7*	*665.6*	*608.8*	*609.8*	*75%*	*0%*	*-7%*
Capital Costs (million €)										
Depreciation of capital	84.7	80.4	183.6	174.4	176.5	174.9	74.7	*9%*	*-57%*	*-49%*
Financial costs, net	8.5	30.3	32.9	21.5	19.6	18.7	18.5	*2%*	*-1%*	*-16%*
Extraordinary costs, net	2.2	2.2	2.8	2.4	2.8	4.0	4.8	*1%*	*19%*	*74%*
Capital Value (million €)										
Total value of assets	1054.6	1066.5	1080.7	1027.2	1088.6	1039.6	1032.3	*127%*	*-1%*	*-3%*
Net Investments	65.5	80.3	65.2	94.7	78.0	68.6	60.0	*7%*	*-13%*	*-20%*
Debt	684.8	664.4	678.9	665.5	642.7	629.1	462.2	*57%*	*-27%*	*-30%*
Input & Production (thousand tonnes)										
Raw material: Feed	51.1	56.5	52.3	28.4	36.0	34.0	36.5		*7%*	*-15%*
Raw material: Livestock	81.8	88.3	66.1	47.8	45.8	48.7	57.2		*17%*	*-9%*
Performance Indicators(million €)										
Gross Value Added	446.1	385.6	475.2	473.8	471.3	412.5	421.1	*52%*	*2%*	*-5%*
Operating cash flow	255.7	182.4	275.3	249.1	229.3	200.5	205.5	*25%*	*3%*	*-11%*
Earning before interest and tax	171.0	102.0	91.7	74.7	52.8	25.6	130.8	*16%*	*411%*	*52%*
Net profit	162.5	71.6	58.8	53.2	33.1	6.9	112.3	*14%*	*1533%*	*75%*
Capital productivity (%)	42.3	36.2	44.0	46.1	43.3	39.7	40.8		*3%*	*-3%*
Return on Investment (%)	16.2	9.6	8.5	7.3	4.9	2.5	12.7		*415%*	*56%*
Future Expectation Indicator (%)	-1.8	0.0	-11.0	-7.8	-9.1	-10.2	-1.4		*86%*	*79%*

Source: EU Member States DCF data submission

For these 6 segments, turnover and total operating costs was relatively stable from 2015 to 2016, reaching respectively €765.2 million and €609.8 million while the total income increased slightly by 1% (Table 10.10.3). In global, aquaculture sector made a positive net profit and had a positive EBIT in 2016. Nevertheless, the evolution of net profit for freshwater farming sector is highly fluctuating and sometimes negative (see below).

Wages and value of unpaid labour represent 36% of the total operating cost (TOC), 40% for the shellfish sector for which techniques need more manipulation of animals. Livestock costs represent 27% of the TOC: 30% in the shellfish sector, 10% in fish sectors where feed costs represent around 44% of the TOC.

Despite the considerable uncertainty regarding future production, subject to natural hazards, professional reinvested to renew their outdated equipment. The item "depreciation of capital" decreased by 49% in 2016 on average 2010-2015. The variability of output also makes cautious professionals on the bank loans. They reduced their level of debt by 30% in 2016 compared to the average 2010-2015.

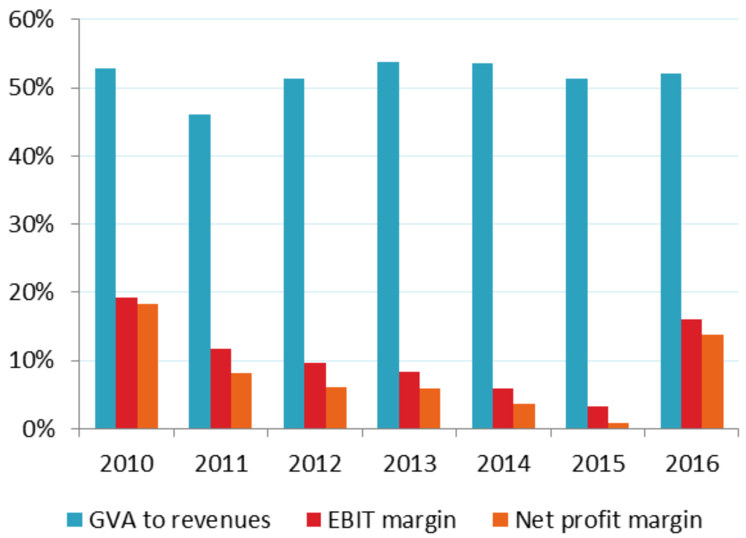


Figure 4.10.3 Economic performance for France: 2010-2016
Source: EU Member States DCF data submission

French aquaculture sector made a positive net profit and had a positive EBIT in 2016. These indicators increased very strongly compared to 2010-2015 (respectively 75% et 52%). In global, return on investment reached 12.7% in 2016.

4.10.4 Main species produced and economic performance by segment

Main species of French aquaculture sector are pacific cupped oyster, blue and Mediterranean mussel, rainbow trout. The weight of Pacific cupped oyster (50% of the volume, 61% of the value) remains important despite the recorded mortality since 2008 (Figure 4.10.4).

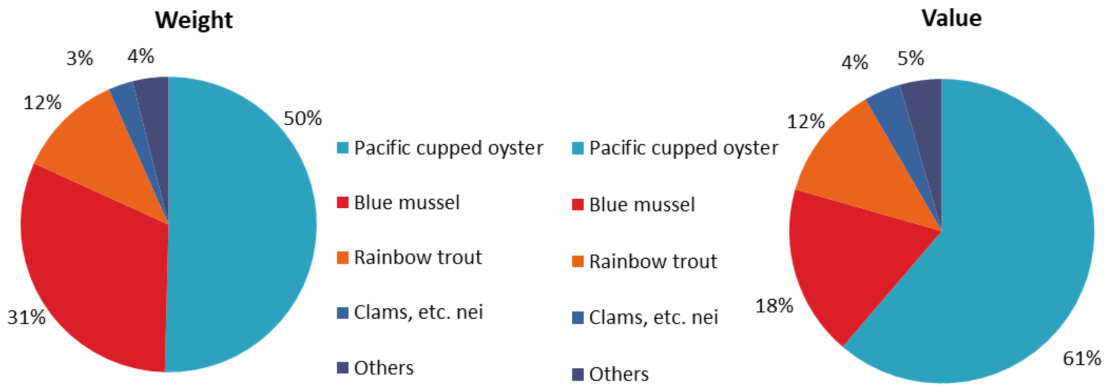


Figure 4.10.4 Main species in terms of weight and value in the French aquaculture production: 2016.
Source: EU Member States DCF data submission

The price is given as a global indicator as volumes and values combine sales of juveniles, young adults sold to other aquaculture farms, adult sold to human consumption. Price for mussels and rainbow trout are quite stable since 2010 (Figure 4.10.5).

For pacific cupped oyster, after stability for some years before 2011, the price increased every year until 2014. This is an effect of the decreasing production sales due to mortalities of juveniles since 2008. The price of oysters seems to have reached an upper limit for the consumer market. In 2015, the price decreases to go up in 2016, but stays below his 2012 level.

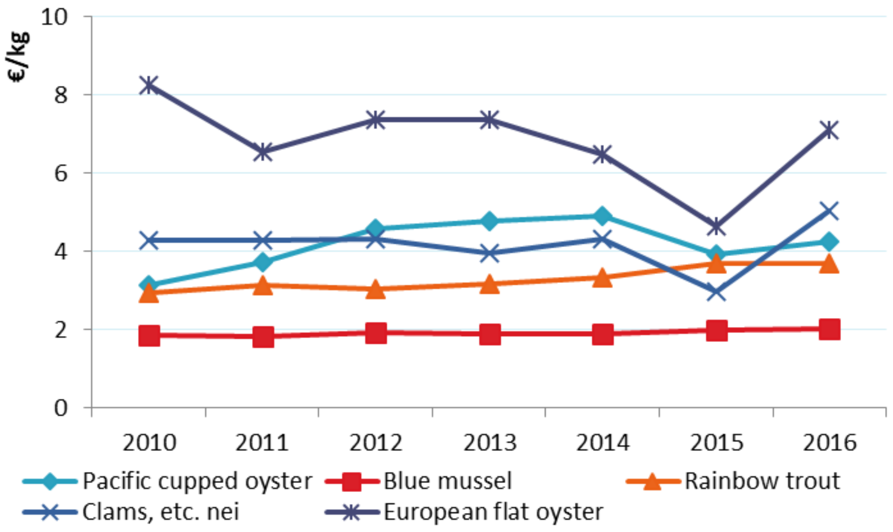


Figure 4.10.5 Average prices for the main species produced in France: 2010-20116.
Source: EU Member States DCF data submission, 2016

The most relevant segments in the French aquaculture are Oyster bottom (segment 1), Mussel bottom (segment 2), Trout on growing (segment 3) and Trout combined (segment 4).

Segment 1: Oyster bottom

Companies in this segment are very heterogeneous (i.e. in terms of size, turnover, etc.), and they have different strategies of production. Some of them focus on one stage of production (short cycle) instead of achieving the whole rearing cycle. The spat is supplied either by wild spat (produced by the farmers themselves thanks to collectors of different kinds in the regions located at the South of Loire, or purchased to these farmers by others), or spat produced in hatcheries, or both. In response of mortalities of spat, hatcheries select and produce more resistant diploid or triploid spats. The production of triploids spat is dominant. If the cost of the seed is higher than the wild seed, the growth of these oysters is faster (shorter production cycle) and rotation of stock is higher. It exists also a last phase of oyster production, the refining ("affinage") of oyster. This additional process, which consists in ending the rearing of oysters by a temporary immersion in marshland ponds ("claires"), provides a significant added-value to the final product. Only the oyster farms of Charente Maritime and Vendée practice this process.

The segment consists of 1 658 enterprises and 5 474 FTE. The sales production volume was 118 921 tonnes with a corresponding turnover of €451 million. The production volume accounts for 54% and the value accounts for 59% of the total French production.

Since 2008, the French oyster industry is facing to mortalities of spat (shellfish less than one year) in pacific cupped oysters: between 60 and 90% mortalities in all breeding sites. The research shows that OsHV1 µvar virus plays an important role in explaining mortality and is clearly associated with bacteria of the genus *Vibrio splendidus*. To cope with these mortalities, several strategies have been implemented. Some companies which have leasehold to collect spat, have increased the number of spat collectors. The work of collector is labour intensive. So, this strategy has conducted to increase the number of seasonal employment. Due to the necessity to handle the supply of natural spat, the demand for spat collection leaseholds has increased and caused a strongly progression of the transfer price between oyster farmers. In complement or not with natural seed, the purchase of juveniles in the hatcheries offered a solution in terms of diversification of oyster juvenile. The consequence is the augmentation of the value of the livestock.

Considering it takes 3 years to produce an oyster, the impact of these mortalities on the economic performance will be measured in 2012 and following years. Firms have received subsidies in order to purchase the spat. Since 2012, the enterprises have resumed their investments. Investments in spat and materiel explain the progression of the total value assets (figure 4.10.6). Turnover to total income ratio reach 93% and profitability was rated 14% in 2016 (-4 point/2010).

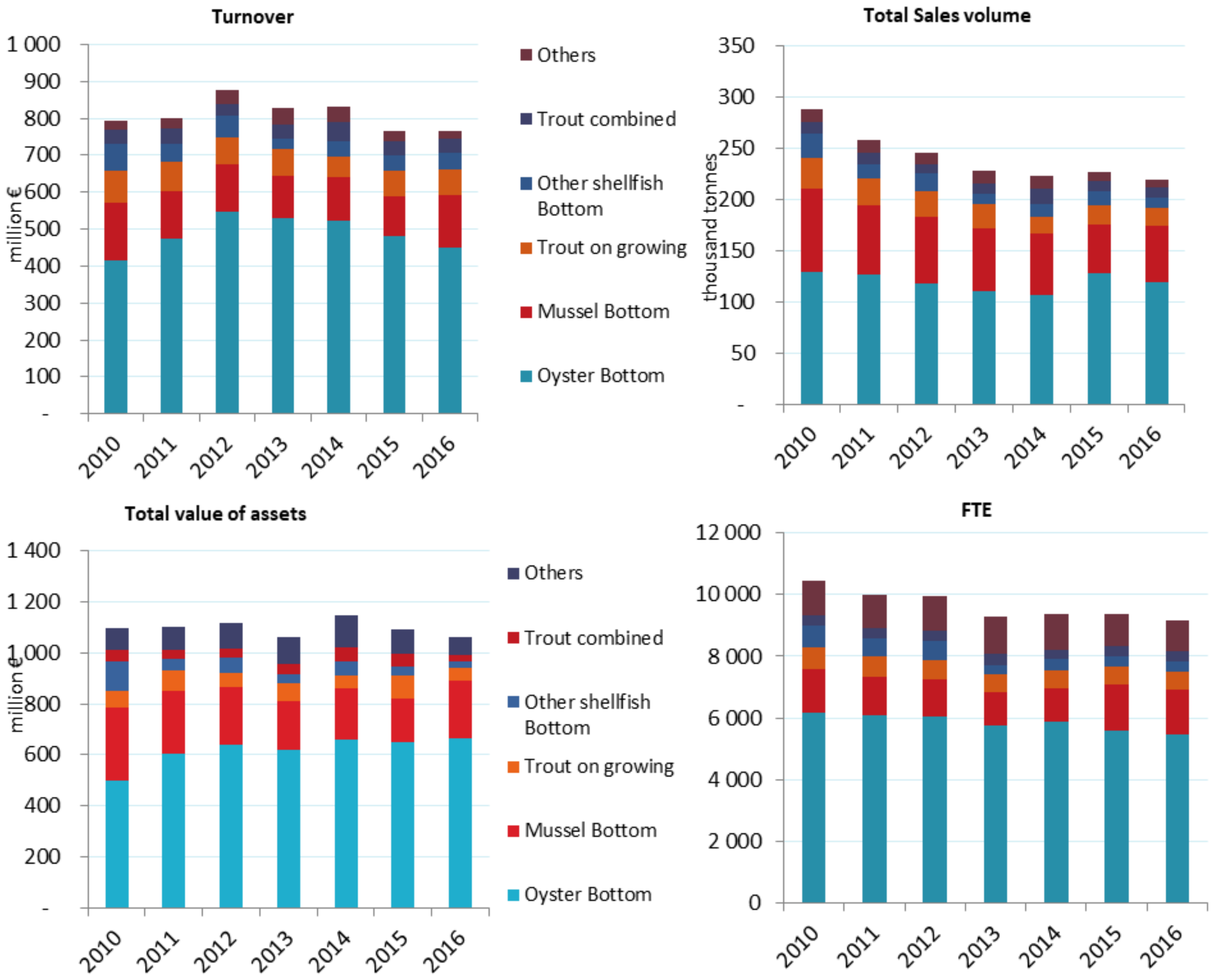


Figure 4.10.6 Structural development French aquaculture sector: 2010-2016.
Source: EU Member States DCF data submission

Segment 2: Mussel bottom

The second most important segment is the mussel bottom and consists of 385 firms and 1426 FTE in 2016. Since 2010, the production of mussel is decreasing. This decline was due to unfavourable weather causing a deficit of production and poor quality of mussels (2011, 2012). The deficit comes also from the resurgence of predators (sea-star) in some areas of production (Channel and Atlantic coasts). Since 2014, a high mortality of mussels has been located in production areas located in the West of France (Pertuis Breton and bay of Bourgneuf). The mortalities have reached up to 100% on the long line for some professionals and 50-80% of the "bouchot" cultivation system. The causes of these mortalities are difficult to establish (pathological, environmental and physiological). Given the short cycle of the mussel, producers cannot replenish their stocks. There is no hatchery of mussels in France. As with a lot of environmental hazard causing shellfish mortalities, the prevention methods or the tools for reducing the economic consequence are limited. Financial difficulties are important (drop in sales, net loss of turnover) while cleaning of leaseholds (remove the mussels) causes significant costs. If older companies have cash to cover fixed costs, young companies, much more indebted, have significant difficulties. Measure 56.1.f of EMFF has been mobilized in order to compensate the mussel farmers impacted.

In 2016, the sales production volume is 55 154 tonnes with corresponding turnover of €142 million (respectively 13% and 34% increase over 2015). This cultivation represents 97% of the value of French mussel turnover and 75% of the weight. Due to the slump in sales, the performance measures indicates decline between 2010 and 2015 in terms of gross value added (-42%), earnings before interest and tax (-66%) and net profit (-70%). Then, in 2016, these indicators increased respectively by 30%, 131% and 156% compared to 2015.

Table 4.10.4 Economic performance of main French aquaculture segments: 2010-2016 (in million €).

Variable	2010	2011	2012	2013	2014	2015	2016	% of total income	Change 2016/15	Development 2016/(2008-15)
Oyster Bottom										
Total income	468.0	523.8	589.6	568.0	566.2	510.3	485.8	100%	-5%	-10%
Gross Value Added	203.2	227.0	289.2	289.9	301.5	260.3	252.3	52%	-3%	-4%
Operating cash flow	100.1	114.0	173.1	158.6	146.2	118.8	108.0	22%	-9%	-20%
Earning before interest and tax	58.9	70.5	68.6	59.1	42.1	11.5	59.4	12%	415%	15%
Net profit	53.7	53.8	51.5	46.9	30.0	-1.3	47.8	10%	3851%	22%
Total sales volume (thousand tonnes)	129.5	126.9	118.4	110.9	106.8	127.4	118.9		-7%	-1%
Mussel Bottom										
Total income	176.8	137.4	135.6	122.5	122.7	109.8	149.0	100%	36%	11%
Gross Value Added	138.2	96.1	100.7	93.0	85.2	79.9	103.7	70%	30%	5%
Operating cash flow	89.8	53.2	61.4	59.7	49.6	53.9	68.1	46%	26%	11%
Earning before interest and tax	65.6	31.1	16.6	28.3	13.8	22.5	52.2	35%	132%	76%
Net profit	63.1	24.3	9.1	23.4	9.5	18.8	48.3	32%	156%	95%
Total sales volume (thousand tonnes)	81.5	67.9	64.4	60.7	59.9	48.7	55.2		13%	-14%
Trout on growing										
Total income	85.4	86.4	87.4	92.8	60.5	72.1	72.6	100%	1%	-10%
Gross Value Added	20.5	10.2	20.4	29.1	13.7	18.5	20.2	28%	9%	8%
Operating cash flow	7.7	-5.8	5.7	3.2	3.3	6.7	9.9	14%	49%	186%
Earning before interest and tax	4.8	-10.0	2.5	-8.9	0.8	3.6	7.3	10%	101%	706%
Net profit	4.1	-12.6	1.2	-9.9	-0.3	2.9	6.1	8%	109%	348%
Total sales volume (thousand tonnes)	29.1	25.3	24.8	24.5	16.6	18.1	18.1		0%	-22%
Trout combined										
Total income	39.7	40.3	37.7	38.8	55.4	44.4	40.3	56%	-9%	-6%
Gross Value Added	17.1	16.2	14.2	12.8	20.1	16.2	12.2	17%	-24%	-24%
Operating cash flow	5.1	6.4	6.4	2.4	5.9	6.0	6.3	9%	4%	16%
Earning before interest and tax	2.3	3.8	4.7	0.3	1.8	4.0	5.2	7%	28%	82%
Net profit	2.2	3.0	1.8	-0.4	2.4	4.2	4.7	6%	12%	113%
Total sales volume (thousand tonnes)	11.3	10.9	8.6	9.9	14.8	9.8	9.8		0%	-10%

Source: EU Member States DCF data submission

Segment 3: Trout on growing

For the trout segments, beside the population of companies having a commercial status that are reported here, France have around 80 enterprises with a non-commercial status (association, federal fish farms): generally, of small size that produce essentially young fish for the restocking of rivers and don't have a real economic activity. There is a wide range of commercial companies from small businesses and some big companies. Small producers focus on local niche markets (sell live fish to stock ponds or river or for sports fishing) whereas medium and large companies are able to offer regularly sufficient quantities to supermarket chains. But they must face pressure from supermarkets, wholesalers and processing industries on prices.

The third segment, trout on growing, is 18 075 tonnes bringing about a total turnover of €69 million. It represents 65% of the whole trout aquaculture in weight and 63% in value. This segment accounts 183 enterprises for 611 FTE or 65% of the total trout FTE. Since 2010, the economic situation in this segment had developed unfavourably despite a slight improvement in 2015. The turnover (-5%), sales volume (-38%), the total value of assets (-21%) and the total number of FTE (-12%) are decreasing between 2010 and 2016. Currently, the equipment and investments are little renewed. The level of depreciation of capital and total asset are the lowest since 2010.

Segment 4: Trout combined

The trout combined activities complete the global trout production with a total income of €40 million and a sale volume of 9 778 tonnes in 2016. The segment consists of 85 firms and 334 FTE. The same decreasing trend between 2010 and 2016 as in the trout on growing segment is observed regarding total sales production (-14%) and total of value of assets (-34%). However, the turnover maintained in the average of the last years. The enterprises in this segment remain profitable in 2016 with a positive net profit.

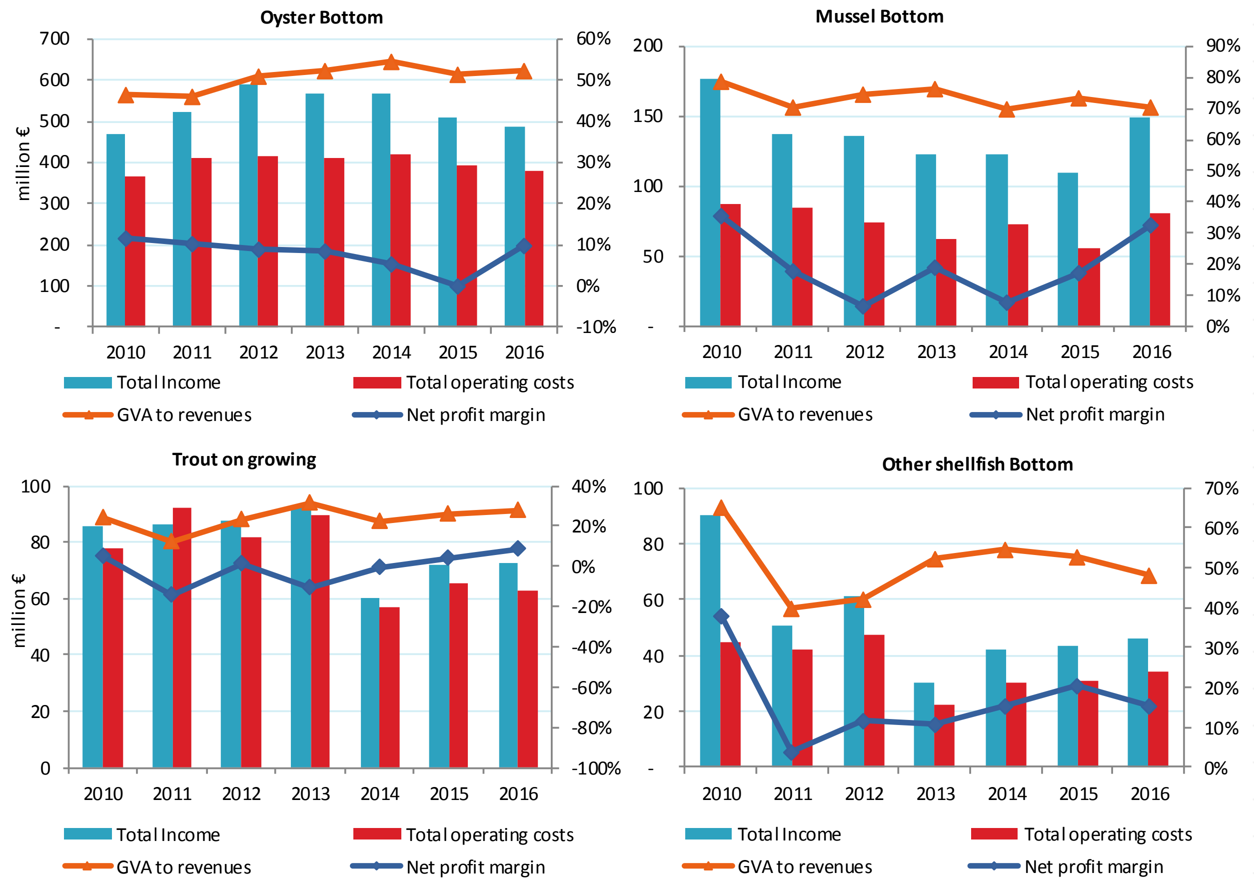


Figure 4.10.7 Economic performance indicators for the main French segments: 2010-2016.
Source: EU Member States DCF data submission

In Figure 4.3.8, the operational cost structures for the four French segments are presented.

Segment 1: Oyster bottom

Livestock is the main cost (29% of the total operating costs and depreciation of capital) as there are exchange of oysters between regions to improve shellfish growth, to supply adults to farmers specialized in “affinage” process. The important demand of spat cause an increase of 19% of the cost of the livestock between 2010 and 2014. In 2016, wages and value of unpaid labour is a high cost (35% of the total costs). After a large amount in 2015, the depreciation of capital decreased by 55% in 2016. Enterprises seem to be pessimistic in 2016. The weight of the depreciation of capital was 11% of the total costs.

Segment 2: Mussel bottom

The most important operational cost items are wages and salaries and the imputed value of unpaid labour. Investments are important for this activity. The depreciation of capital item attains 38% of the total: operating costs and depreciation of capital. In the case of mussel farming, the spat supply is exclusively on wild source, so the livestock costs are limited (13%).

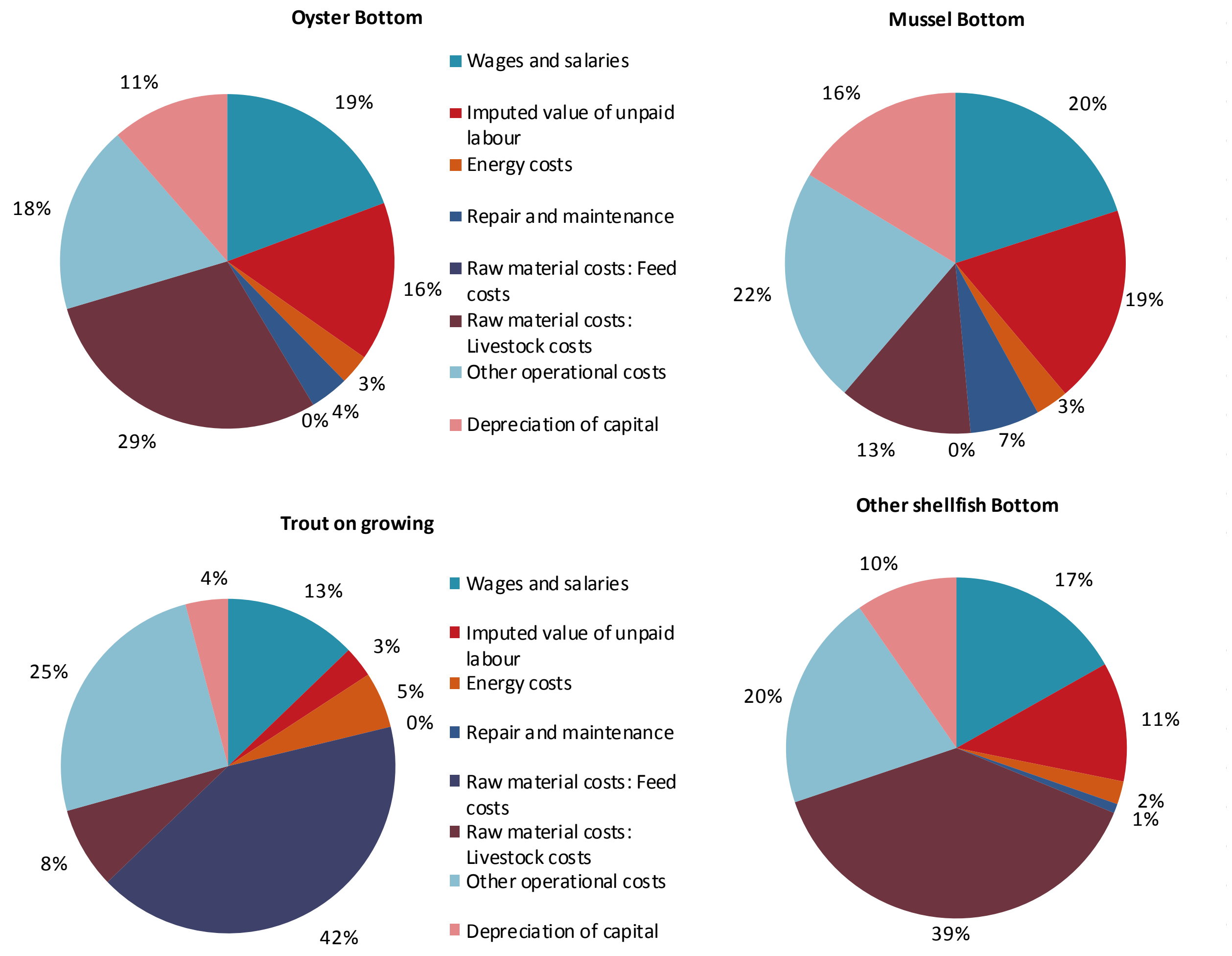


Figure 4.10.8 Cost structure of the main segments in French: 2016.
Source: EU Member States DCF data submission

Segment 3: Trout on growing

The trout on growing segment show the traditional cost composition for freshwater aquaculture industry, where the main cost components are feed which covers 42% of the total operational costs in 2016.

Segment 4: Trout combined

As these farmers have to feed their juveniles, also the adults that they are rearing up for their own production, feed costs are also high (43% of the total: operational costs and depreciation of capital in 2016). Livestock costs increased and reached 12%. The second operational cost items are wages and salaries.

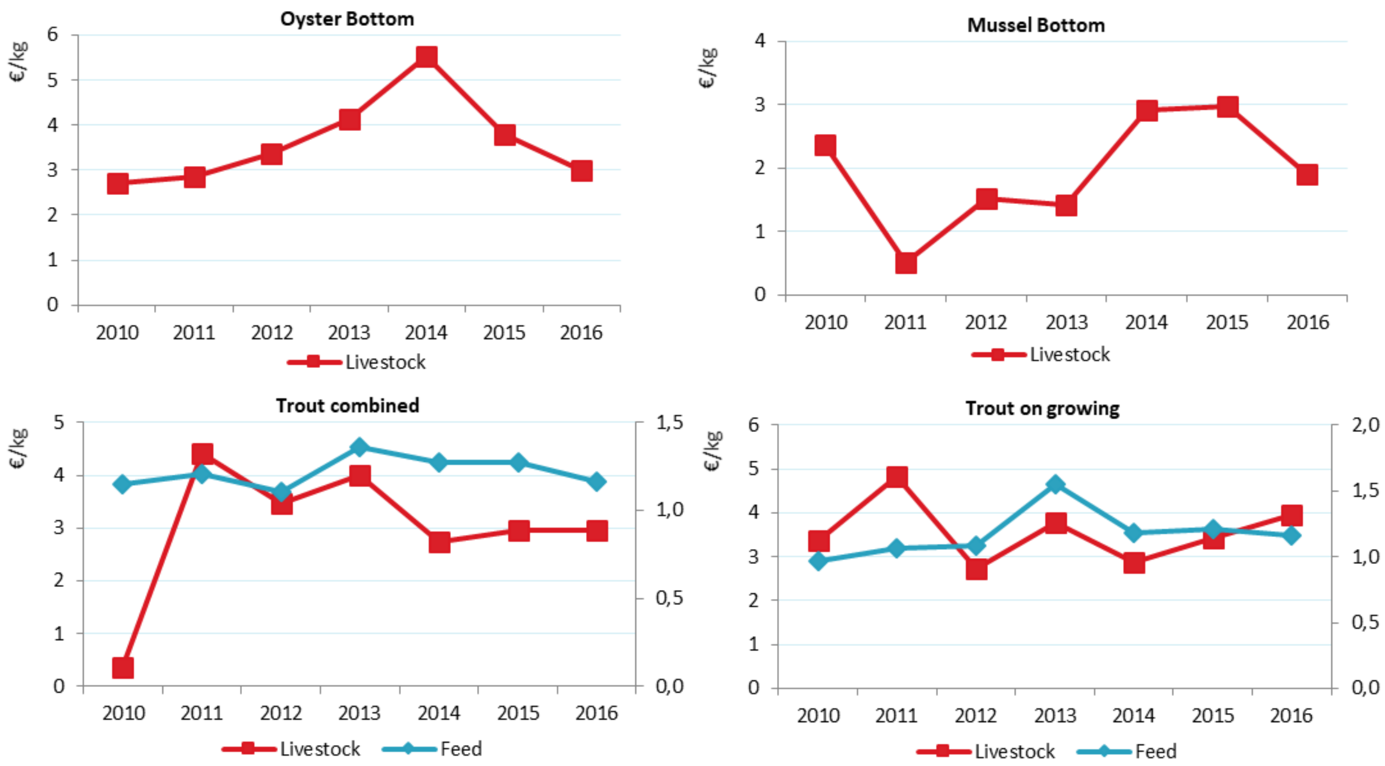


Figure 4.10.9 Feed and livestock prices for the main French segments: 2010-2016.
Source: EU Member States DCF data submission

4.10.5 Trends and triggers

Current production trends and main drivers

In the oyster sector, since 2008, the mortalities of spat have impacted noticeably the production. The main concern of oyster farmers is to maintain profitability. This expected level of requirement leads oyster farmers to keep an adequate level of livestock through the number of spat collectors and their purchase in the hatcheries. The situation is more difficult for professionals with no leasehold, the livestock costs item carry weight. The control of stocks in breeding and in particular for the supply of spat is still a major issue. Oyster farmers have integrated spat mortality risk and consider that less than one reared oyster will reach market size for sale. In Poitou-Charentes (first oyster region), the mortality rate of oyster one year aged was 45% (average 1994-2006), 75% on 2008-2014 period, 60% in 2015 and 63% in 2016 (source: CREAA). These mortality fluctuations induce constantly problem in terms of adjustment of financial or human resources for example. The same situation and consequences are observed in the mussel activity where high mortalities are observed since 2014 in two region of France.

Since 2015, in Mediterranean, shellfish producers deal with to sale bans due to HAB's (Alexandrium catenella) or norovirus during autumn. The duration of bans can reach 5 weeks among years.

The freshwater production has shown a downward trend of production over the years, the number of firms and employment decreased. Total production has declined compared to the production of 1995, due to a non-competitive production cost, of volatile global prices and the difficulties with installing or expansion encountered (conflicts of uses, binding regulations, strong competition from other imported fish, etc.). Developing for a sustainable production is done with the respect of constraints related to the Water Framework Directive (WFD), the Water Act at national level, sanitary regulations. French fish farmers hope that these different efforts will be adequate to consolidate the positive economic results observed in 2014 and the demand of the French consumers for quality fish.

By simplifying the administrative procedures for aquaculture authorisation, by a better integration of aquaculture activities in the regional development planning, the number of farming site should be more important in the future.

Market structure

The fluctuations of shellfish production levels in relation to environmental hazards, leads fluctuations of prices on the different markets (between shellfish farmers, with retailers or wholesalers). In a context of high uncertainty, the lack of knowledge about the future sales do not facilitate the shellfish farms management.

In 2016, France exported 12°620 tonnes of oysters and imported 7°988 tonnes, what released a €55 million credit balance. The exchanges of oysters are marginal compared with the production which allows to answer the domestic demand. The challenge to increase the quantities produced oysters limit development prospects of exports. French mussel production is not adequate to meet the national demand. The imports of mussels (60°727 tonnes in 2016) mainly, from Netherlands (fresh mussels), Chile (canned mussels) and Spain (fresh mussels), exceed widely the exports (3°628 tonnes) revealing a €80 million trade deficit. Three-quarters of imports are in fresh, 23% are frozen mussel or canned, the rest being frozen.

The freshwater sector is facing to difficulties market and environmental constraints. This results in particular a growing number of requirements related to the evolution of the market demand, economic competitiveness, quality of management of the environment and the social acceptability of production methods. Ensure the necessary development of the French fish also becomes more complex in the context of globalized trade of aquatic products. French products are in competition with foreign domestic productions where natural conditions, social and environmental standards are more advantageous. In 2016, France exported 7°760 tonnes of trout and imported 5°168 tonnes, what released a €4.1 million credit balance. Nevertheless, imported quantities of salmon are very important (164.8 thousand tonnes) compared to exported quantities (21.4 thousand tonnes) revealing an €818.5 million trade deficit.

Issues of special interest

Shellfish farmers must implement risk hedging instruments based on self-insurance (in particular saving) and must discuss with State in order to create a mutual fund involving an equal financing between professional and public instances. The involving of shellfish farmers in terms financial must be important in the future while environmental hazards multiply.

Outlook for production and trends

In the oyster sector, the situation of mortalities of spat is continuing. Since 2008, the supply of spat and the management of the stock remains a crucial issue. In 2015 and 2016, a high mortality of mussels observed in the West of France (Pertuis Breton, Bay of Bourngeuf) is continuing.

Shellfish farmers dread climate change increasing risk of epizootic and the emergence of diseases in the marine environment. This climate change will affect the environmental parameters: temperature change on ocean acidification, on rainfall and therefore the salinity and the concentration and nutrient quality. This will have consequences on future aquaculture output and on the economic results.

4.10.6 Data Coverage and Data Quality

Data quality

In 2010, DPMA with LEMNA, an economy laboratory from Nantes University, have set up a working group with 2 subgroups: shellfish farming, fish farming. Each subgroup has clarified how production data should be used to determine the membership of each enterprise to a particular DCF segment as no precise recommendation was found in the DCF regulation, especially on species level for shellfish. To improve the accuracy of sampling, the subgroup defined the stratification to be applied within each segment. The subgroups had also to characterize more precisely the content of each economic indicator.

For shellfish farming, the subgroup involves two enterprise accounts management centres that transmit economic data, on anonymous basis, from a sample of the accounting records of enterprises that they follow. To determine the membership of an enterprise to a segment and stratum, to give full detailed economic data, these centres collect additional data to the standard accounting records.

The planned sample rate is 15% overall (from 16% to 25%) and could be realised for the main segments. Apart from production and employment, economic data are not transmitted for some segments in 2016: mussel raft and long line, and other shellfish on long line. The low sampling rate (6%), leading to high CV's explains this result. Enterprises in these segments are located on Mediterranean coast where the enterprise accounts management centres have started to collect the additional data needed for our economic collection in 2012. In addition, many enterprises are individual units and don't have accounting records. The effort in order to consolidate the sample must be reinforced in the future.

For year 2016, the socioeconomic data of 421 enterprises in the shellfish farms segments was collected (274 in 2010) representing 17% of the population. The main segments had an appropriate sampling rate, giving a good precision.

The socioeconomic data of 3 enterprises in the marine fish segments was collected, covering the sea bass and sea bream segments. The achieved sampling rate low for the cage segment (25%) representing a limited population of 15 enterprises with a high variation from small farms to very important ones, giving a poor precision. Due to restructuration for one big size enterprise, the very small population (5 units) of the sea bass – sea bream hatcheries & nurseries segments can't be provided properly since 2012.

The socio-economic data of 52 enterprises in the trout segments was collected for year 2016, representing 20% of the population. As these segments show a high variation from small farms to very important ones, this sampling rate give a medium precision for economic data.

Data availability

Decision to consider shellfish farms in "oysters" or "mussels" segments is based on the turnover ratio of one of these species group to the overall turnover; otherwise the firm is included in "other shellfish". Since 2010, this minimum ratio was fixed to 60% of the total turnover but segmentation was not updated for years 2008 and 2009 to respect this level.

For the period 2010-2016, economic parameters (turnover, subsidies, other income, total income, wages and salaries, imputed value of unpaid labour, energy costs, raw material costs: livestock costs, raw material costs: feed costs, repair and maintenance, other operational costs, depreciation of capital, financial costs net, extraordinary costs net, total value of assets, net investments, debt, raw material volume: livestock, raw material volume: feed) are not available for all segments, but the main ones.

These economic parameters are available for 6 segments corresponding to 85% of the total turnover in 2016. Therefore, even if total data is presented for the whole French aquaculture sector, economic indicators have been calculated only using data for these main indicators where all economic data was available.

Confidentiality

Production data (in weight and value) are assed via an exhaustive survey realised by the statistical service of French fisheries organisation. This survey is registered to the national committee for statistical information and must follow rules for statistical confidentiality: published results aggregated from a minimum of 3 enterprises and one unit doesn't represent more than 85% of the group total.

As part of the DCF data rely on production, segments defined by France try to follow this rule, by example: "Other marine fish" segment is a mix of some enterprises quite different one to another in size and grown species.

But some situation of statistical confidentiality may still occur when data within segment are disaggregated, by example: number of enterprise by employment size.

Differences in DCF data compared with other official data sources

In application of regulation EC 762/2008 of the European Parliament and of the Council, France is reporting every year the production in volume and unit price to Eurostat with a copy to FAO statistics unit. The production concerns mainly the adult animals which are sold for human consumption in general, for river restocking or recreational fishing additionally in the case of fresh water farming. These numbers don't take in account the commercial activity between farmers for livestock exchange at intermediate growth stages, including shellfish spat collected from sea.

Economic data transmitted in the DCF program are reporting in one hand the whole sales (in volume and turnover) from the enterprises: adult products sold for human consumption or river restocking for fresh water fish, animals (adults or juveniles from nurseries or shellfish spat) sold from one farm to another one which will carry on subsequent rearing up. In another hand, economic data include livestock bought (in volume and cost) by enterprises from other farmers.

This explains the main difference between Eurostat production data and DCF turnover figures.

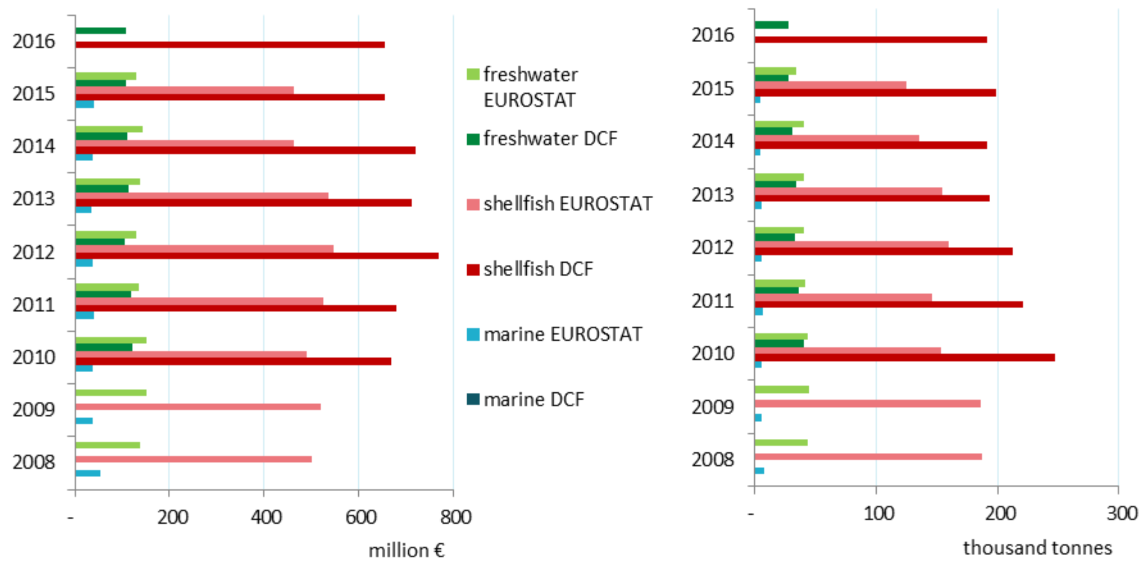


Figure 4.10.10 Comparison of DCF data with EUROSTAT data for France: 2008-2016

4.11 Germany

4.11.1 Production and sales

Blue mussel (*Mytilus edulis*), trout (mainly rainbow (*Oncorhynchus mykiss*), brown (*Salmo trutta fario*) and brook trout (*Salvelinus fontinalis* and *Salvelinus alpinus × fontinalis*)) and carp (*Cyprinus carpio*) are the most important species in German aquaculture. According to DCF regulation EU 2017/1004 the provision of marine aquaculture is mandatory, freshwater aquaculture data is not. In 2015 and 2016 only economic data on blue mussels has been available in details. For the other segments the report is restricted to production volume, estimated turnover, number of employees and number of enterprises, which are collected under the Eurostat aquaculture statistics regulation.

The blue mussel production was with around 22 200 tonnes the strongest segment in 2016. In 2015, the picture is different. Blue mussel production was around 12 800 tonnes. In opposite, there were almost no change for trout (10 700 tonnes). Carp farms produced around 5 200 tonnes volume in 2016 plus its traditional secondary species - mainly sturgeon (*Acipenser ruthenus*), tench (*Tinca tinca*), pike (*Esox lucius*), perch (*Perca fluviatilis*), European cat fish (*Silurus glanis*) and pike perch (*Sander lucioperca*), which is not reported in details, but should be about 10% of total carp production. Niche segments like cat fish (*Clariidae* and *Siluridae*), eel (*Anguilla anguilla*) or sturgeon (*Acipenseridae*) farming etc. provide the rest of total freshwater production. Altogether, the niche segments have a share less than 20% of the total German production. There were only slight changes for carp (4 900 tonnes), caused among other factors by a serious drought in carp producing regions in Bavaria in 2015. The value of blue mussel sales was €13.7 Million in 2015 and €25.3 Million in 2016. The sales for total carp and salmonid production has been roughly estimated via known production volume and average market prices (national statistics, Bundesamt für Statistik, Destatis 2018) to be about €80 Million in 2015 and €77 Million in 2016; not including the value of secondary species from carp production. Further, niche segments like eel, cat fish and sturgeon are assumed to have an overall value of about €13 Million. Among other things the decrease in value for freshwater species was caused by declining prices for brook trout and carp in 2016. In total, the author's estimations of values are basically in line with the (estimated) value from Eurostat, which account for a total value of the German aquaculture sector of about €118.5 Million in 2016 and €105.5 Million in 2015. The difference in the total corresponds again mostly to the very good blue mussel harvest in 2016. The decline in volume and value from 2014 to 2015 is caused in adjusted survey methods for freshwater aquaculture statistics. The national Federal Statistical Office of Germany (Bundesamt für Statistik, Destatis) introduced new thresholds in 2015, which do not consider smallest farms any more (cf. chapter on data quality).

Table 4.11.1 Production and sales for Germany 2008-2016

Variable	2008	2009	2010	2011*	2012*	2013	2014	2015**	2016	Change 2016/15	Developm. 2016/ (08-15)
Sales weight (thousand tonnes)	***43.7***	***40.2***	***40.6***	***36.2***	***25.4***	***25.3***	***27.3***	***31.2***	***41.1***	*31%*	*22%*
Marine											
Shellfish	6.8	4.0	4.9	19.2	6.7	5.2	6.9	12.8	22.2	*74%*	*168%*
Freshwater	37.0	36.3	35.7	17.0	18.7	20.1	20.4	18.5	18.8	*2%*	*-26%*
Hatcheries & nurseries											
Sales value (million €)	***96.3***	***94.0***	***94.0***	***103.0***	***90.9***	***103.9***	***109.9***	***107.7***	***128.8***	*20%*	*29%*
Marine											
Shellfish	9.7	5.0	4.1	27.8	9.5	8.7	15.0	13.7	25.3	*84%*	*116%*
Freshwater	86.6	88.9	89.9	75.2	81.4	95.2	94.9	94.0	103.6	*10%*	*17%*
Hatcheries & nurseries											

*Introduction of Destatis statistical survey; population incomplete.

** Introduction of thresholds in Destatis statistical survey.

Source: EU Member States DCF data submission, Eurostat, Destatis 2018.

4.11.2 Main species produced and economic performance by segment

The German aquaculture sector is small and highly diverse at the same time. Around 3 300 farms (>0.3 ha or 200 m²) cultivate fish and seafood in Germany. The sector is characterized by small family businesses. Blue mussel as marine aquaculture species, trout and carp farming as freshwater production systems dominate the sector. In terms of value blue mussels were the most important segment caused by a very good harvest season in 2016. Nonetheless, in terms of value rainbow trout is the most valuable segment of the sector.

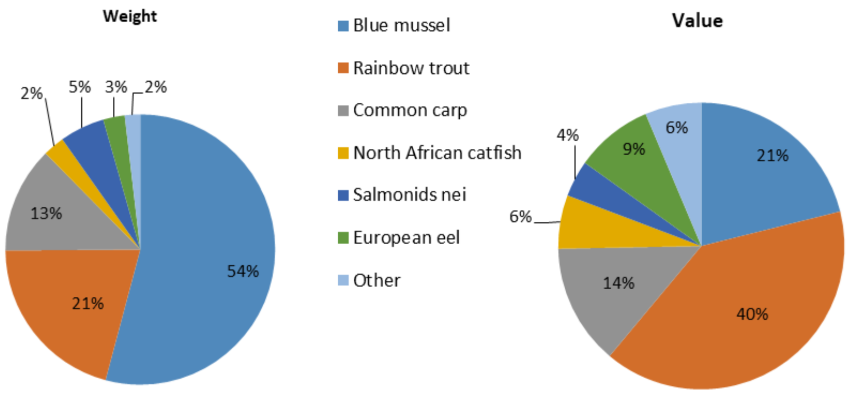


Figure 4.11.2 Share of volume (total 41 000 tonnes) and sales value (total €128.8 Million) per species of the German aquaculture sector 2016

Source: Eurostat (freshwater species) and EU Member States DCF data submission (blue mussel)

All blue mussel enterprises are located in the federal states of Lower-Saxony and Schleswig-Holstein holding licenses from the states. These licenses are given for a restricted time. Mussel producers are obliged to form producer organisations. In consequence, the number of enterprises are stable around 10 producers. The growing rate in Schleswig-Holstein is much more favourable than in Lower-Saxony, caused by a couple of (human) activities there; particular the massive ocean dumping from German rivers like Elbe, Weser and Ems and harbours are seen as negative for the blue mussel growing rate. Ocean dumping, shortage of seed, closing fishing areas, storms and the ongoing expansion of the pacific oyster (*Crassostrea gigas*) are negative impacts towards the blue mussel production and can affect business seriously.

The majority of freshwater farms are small. They often operate as additional income source and are run in part-time. Only 14% of farms (2015) produce more than 5 tonnes per year. Carp and salmonids together have a share of >80% of the total volume of freshwater fish production. The peasant structure of the sector leads to low investments, which hampers industrialization and profit maximization. On the other hand, it ensures a more or less stable production situation. Trout production mainly takes place in the federal states of Baden-Württemberg, Bavaria, Lower Saxony and North Rhine-Westphalia. Together, these four states provide >80% of the German trout production. Ponds and raceways are the main production systems. Only a very few enterprises using partly recirculation systems based on the example of Danish Model Farms. These few farms are relatively the large, often producing more than 100 tonnes per year and have a significant impact on the total quantities. Carp production is mainly located in Bavaria, Saxony and Brandenburg. These three states provide >80% of the total German carp production. While there are larger farms in Saxony and Brandenburg, Bavarian carp production is characterized by peasant farming as additional business or as an integrated system in a terrestrial farm. Almost all carp production systems are earthen pond systems stocked in polyculture.

As economic data for the freshwater segments are not reported in detail for 2015 and 2016, the following tables just reflect the situation in the blue mussel segment. The fluctuation in the economic development of the blue mussel sector is well seen in the recent years by an almost stable structure of inputs. Notwithstanding, 2016 has been an exorbitant good harvest year.

Table 4.11.3 Economic performance of the German blue mussel segment: 2008-2016

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	% of total income	Change 2016-15	Development 2016/(2008-15)
Income (million €)												
Turnover	9.7	5.0	4.1	27.8	9.5	8.7	15.0	13.7	25.3	*100%*	*84%*	*116%*
Other income	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	*0%*	*-49%*	*28%*
Subsidies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Total income	*9.8*	*5.1*	*4.1*	*27.8*	*9.5*	*8.7*	*15.0*	*13.8*	*25.3*	*100%*	*84%*	*116%*
Expenditures (million €)												
Wages and salaries	3.1	2.9	2.9	3.6	3.2	3.0	3.3	2.6	3.5	*14%*	*35%*	*15%*
Imputed value of unpaid labour	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	*3%*	*133%*	*1765%*
Energy costs	1.2	0.5	0.3	2.2	1.9	0.3	0.4	0.8	0.7	*3%*	*-9%*	*-23%*
Repair and maintenance	0.6	0.3	0.4	0.8	0.7	0.8	1.0	1.0	3.8	*15%*	*272%*	*447%*
Raw material: Feed costs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Raw material: Livestock costs	0.0	0.4	0.0	0.0	0.0	0.0	0.0	2.4	2.6	*10%*	*10%*	*644%*
Other operational costs	1.4	1.1	0.9	1.8	1.8	2.0	4.2	1.2	3.7	*15%*	*216%*	*107%*
Total operating costs	*6.3*	*5.3*	*4.4*	*8.3*	*7.5*	*6.1*	*8.9*	*8.3*	*15.1*	*60%*	*81%*	*119%*
Capital Costs (million €)												
Depreciation of capital	1.5	0.4	1.1	2.9	2.9	2.4	2.4	1.0	1.5	*6%*	*52%*	*-18%*
Financial costs, net	0.3	0.2	0.1	0.3	0.3	0.2	0.2	0.1	0.6	*2%*	*644%*	*186%*
Extraordinary costs, net	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Capital Value (million €)												
Total value of assets	14.7	14.3	11.8	25.5	24.0	22.5	21.0	16.0	44.9	*178%*	*181%*	*140%*
Net Investments	0.5	0.1	0.0	1.5	0.4	0.9	1.8	0.3	12.8	*50%*	*3934%*	*1743%*
Debt	4.0	2.9	2.7	5.5	5.0	5.4	4.9	2.6	9.3	*37%*	*254%*	*125%*
Input & Production (thousand tonnes)												
Raw material: Feed												
Raw material: Livestock												
Performance Indicators(million €)												
Gross Value Added	6.6	2.7	2.5	23.1	5.2	5.6	9.3	8.3	14.4	*57%*	*73%*	*82%*
Operating cash flow	3.5	-0.2	-0.3	19.5	1.9	2.6	6.0	5.4	10.2	*40%*	*88%*	*112%*
Earning before interest and tax	2.0	-0.6	-1.4	16.6	-1.0	0.2	3.6	4.4	8.7	*34%*	*96%*	*191%*
Net profit	1.7	-0.8	-1.5	16.3	-1.2	0.0	3.4	4.4	8.1	*32%*	*86%*	*191%*
Capital productivity (%)	45.1	18.7	21.5	90.6	21.6	24.7	44.5	52.2	32.0	*127%*	*-39%*	*-20%*
Return on Investment (%)	13.6	-4.1	-11.8	65.1	-4.0	0.9	17.3	27.8	19.4	*77%*	*-30%*	*48%*
Future Expectation Indicator (%)	-7.2	-1.9	-9.1	-5.5	-10.4	-6.7	-2.9	-4.2	25.0	*99%*	*693%*	*519%*

Source: EU Member States DCF data submission

Although there were costs for import of seeds reported, the reported quantities of livestock are inconsistent. In consequence, they are not considered in Table 4.11.4. On average the segment is profitable. Very successful years like 2011 and 2016 can overcompensate years of lower income. However, the single labour productivity for 2011 seems to be caused by inconsistent data, too. In general, an income of around one million Euro per company or €800 000 per vessel is needed on an average to cover all costs and be profitable. The price for blue mussel depends very much on quality and supply from other countries, as almost all domestic production is sold via the auctions in Yerseke in the Netherlands. The mussel producers gained in an average €1.14 per kg live or fresh weight (LW) in 2016 and 1.07 €/kg LW in 2015. Although, prices were a little better in 2016 than in 2015, they have not reached the standard of recent years, because the high supply met an almost unchanged demand.

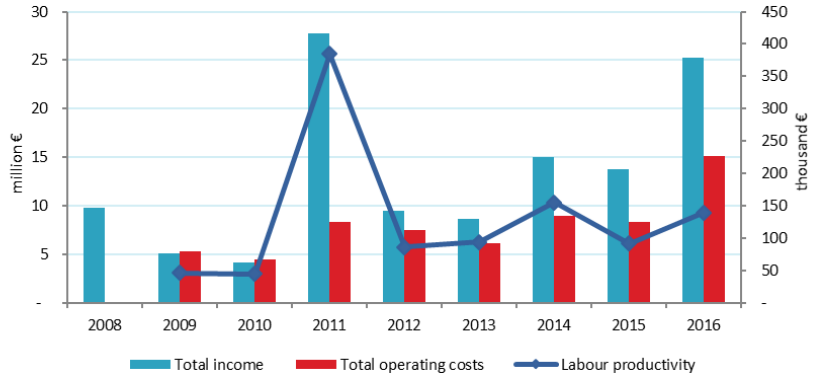


Figure 4.11.2 Income, operating costs and labour productivity of the German <u>blue mussel segment</u> 2008-2016
Source: EU Member States DCF data submission

As the number of licenses in the mussel segment are fixed and most costs items are more or less fixed as well (diesel is not a main cost driver due to short distances from ports to mussel cultures), the development of costs is quite stable. Wages and salaries, repair and maintenance and other operational costs are the drivers of German blue mussel aquaculture. There are no feed costs in mussel farming.

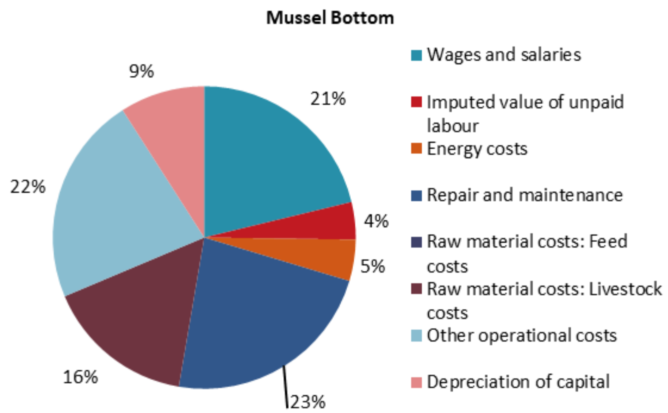


Figure 4.11.3 Cost shares in German <u>blue mussel segment</u> 2016

Source: EU Member States DCF data submission

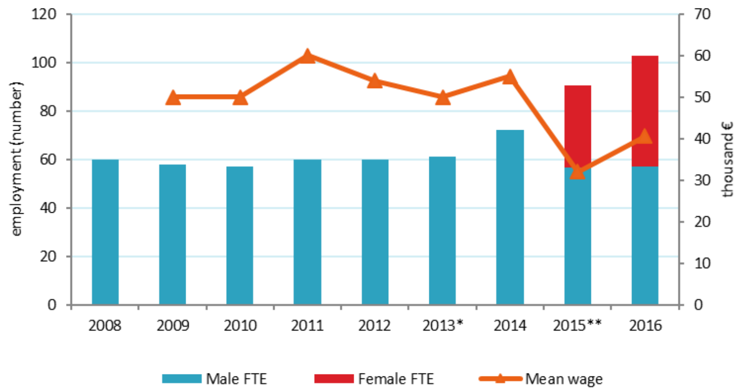


Figure 4.11.4 Employment trends for the <u>blue mussel segment</u>: 2008-2016.
*since 2013 according to National Labour Agency (Bundesagentur für Arbeit).
** since 2015 EU Member States DCF data submission based on National Labour Agency (Bundesagentur für Arbeit) considering gender.
Source: EU Member States DCF data submission and National Labour Agency (Bundesagentur für Arbeit).

The source of employment data has changed in the recent years. In consequence, comparing data from 2015 backwards is limited. The change from 2015 to 2016 is mainly caused by an increase of causal contracts corresponding with the good harvest of blue mussels in 2016. In case of marine aquaculture, 127 people were registered as employees in 2016 and 114 in 2015 at the National Labour Agency (Bundesagentur für Arbeit 2018). They count for presumed 103 FTEs in 2016 and 90.5 FTEs in 2015 assuming that part-time workers count for 0.5 FTE in an average. Most of the permanent (full-time) employees in marine aquaculture are male (60% in 2016 and 68% in 2015), while for part-time employees the picture is converse (63% female in 2016 and 55% female in 2015). According to the vessels’ logbook data, the blue mussel collectors’ crews counted for 31 persons in both years.

According to the National Labour Agency 1 865 people were employed (including permanent labour, apprentices and caused labour) in the freshwater aquaculture segments in 2016 and 1 891 in 2015. Around 70% of the employees are men. 775 employees of all employees were hired on a marginal level (part-time) in 2016, 789 in 2015. The gender relation was almost balanced between the sex in both years for part-time labour. The different types of employment result in an estimated FTE for the freshwater aquaculture sector of 1 477.5 in 2016 and in 1 496.5 FTEs in 2015. Likewise, the production, the employment in both years are almost stable. Please take into account, that the shown numbers do not consider unpaid labour, which is central in sector characterized by small family enterprises.

The prices for freshwater fish vary a lot, depending on the species, product, region and distribution channel. There is a wide range of different prices. On a national average, farmer’s prices for rainbow trout were between 4.21 €/kg LW paid by wholesalers and 7.15 €/kg LW paid directly by the consumer at the farm’s gate in 2016. Other salmonids gained higher prices. Brook trout were sold for 10.60 €/kg LW on a national average in direct marketing and 5.66 €/kg LW for wholesaler. The price gained by carp farmers in the direct marketing of the fish has been in a national average 4.54 €/kg LW and paid by wholesalers 2.25 €/kg LW in 2016.

In 2015, farmer’s prices for rainbow trout varied between 3.75 €/kg LW paid by wholesalers and 7.50 €/kg LW paid by the consumer at the farm’s gate. Other salmonids gained higher prices. Brook trout were sold for 11.88 €/kg LW on a national average in direct marketing and 5.90 €/kg LW for wholesaler. The price gained by carp farmers in the direct marketing of the fish has been in a national average 5.00 €/kg LW and paid by wholesalers 2.38 €/kg LW in 2015. By tendency, it seems that prices rise slightly, but not for all species. E.g. direct marketing prices for brook trout decreases a little.

4.11.3 Trends and triggers

Current production trends and main drivers

The production in Germany is almost stable. The only exception is the harvest of blue mussels, which depends more than the other segments on changing natural conditions. Seed mussels are collected and transferred to cultural areas. As the seed fall in recent years were poor, producers started to collect mussel seed by longlines and/or imported seed from the Netherlands. The collection of seeds via longlines has been on the edge or below of profitability. During the grow-out period of about two years, mussels are susceptible to natural conditions in the German North Sea. Stricter regulations of the fishing areas, which are all located inside the Wadden Sea National Park, lead to complex pre-conditions for mussel aquaculture. The majority of the freshwater aquaculture sector is characterized by smallest and small peasant farms, whereof some of them struggle with profitability, mainly caused by fish loss through diseases and protected wild life (in particular mortality caused by cormorants in carp aquaculture). In some regions like the Bavarian Aischgrund the fish loss is up to 70% for one summer. Hot summers and droughts lead to additional loss in production. As example, Speierl, Abt, Schwinger, Kuhlen and Thoma (2017) estimated an extra -20% of productivity loss for carp production in the Aischgrund (Bavaria). Trout farms, which depend of surface water as inflow, had to stop feeding during the summer months in some regions in 2015. New investments seem to be hampered by complicated and strict regulations and limited access to new inflow water licenses. Although some federal states support the sector with strong application support towards the authorization of new aquaculture facilities, the overall picture has not changed yet. A trend in salmonid cultures is the strengthen role of local species like brown trout or other high value species like brook trout. Also region-marketing measures initiated by Fisheries Local Action Groups (FLAG) seem to have a positive impact towards single fish regions as well as the ongoing diversification of fish products (trout caviar or bone-cut carp fillets). The few new companies focus on new high premium species, e.g. shrimps farming in RAS close to metropolitan areas. But those entrepreneurships address very limited niche markets, which are not able to stimulate a general turnaround for the sector.

Outlook for future production trends

Germany has an established traditional aquaculture sector, where the majority of farms are small family farms. It is stated in several strategies and in particular the national aquaculture strategy from 2014 (Nationaler Strategieplan Aquakultur, NASTAQ), that there is a societal need to maintain these farms, also as basement for the German aquaculture economic. In general, they meet a local and stable demand for domestic aquaculture fish. Moreover, extensive farms provide both cultural and ecosystem services. E.g. carp farms support biological diversity by providing enclaves for nature with their close-to nature earthen ponds, serving simultaneously as water reservoirs. But, taking into account the political discourse of a growth in aquaculture, larger scaled modern facilities are needed. Only a few farms can be seen as international competitive in Germany. If the political will is to lower the support from fish imports, there is a need to strengthen the attractiveness of the aquaculture sector for external investors. First and foremost, salmonids (trout) seem to have the potential to meet an already existing market demand in Germany. All the recent measures to create a significant increase of carp consumption in former years seem to do well in stabilizing the market, but there is no indication that carp will have a higher market share in future. The introduction of new high value species attracts single entrepreneurships, but their market potential seems to be very limited. Nonetheless, an ongoing reform of the regulative framework resulting in a simplified authorization process (including a national coordination of the 16 federal states), better access to inflow water licenses and an economic healthy balance between the objectives of aquaculture sector and conservation is still needed. If the fish loss due protected wildlife in carp farming will be ongoing at the actual high standard or not be compensated, carp farms will continue to struggle economically and may be forced to close down in some region. Actually, there is already a lack of successors. But, extensive carp farms are seen as contributors of ecosystem services and regional culture, which maintain the unique pond landscape of the production regions. A stronger appreciation and a re-numeration of their societal contributions would help to enhance their profitability, which has been critical in many cases in 2016 and 2015. A positive trend can be seen in the further acceptance of quality and regional labels like the Protected Geographic Indication (PGI), which lead in some regions towards higher fish prices in the local and direct marketing.

4.11.4 Data Coverage and Data Quality

Until 2011, aquaculture statistics based on (partly estimated) data from the sixteen federal states’ fisheries authorities (Brämick 2013 et seq.). Since that time, the national Federal Statistical Office of Germany (Bundesamt für Statistik, Destatis) has taken over central responsibility. It conducts the data directly via an annual census among fish farmers to be in line with the European Regulation EC No 762/2008. Nonetheless, for several reasons the data quality of Germany’s aquaculture has been seen as unsatisfactory: The official statistic counts the fish, which is sold in the concerned year; former statistics counted the harvest fish. Furthermore, the official statistic does not consider sales of fish, which is destined for re-stocking purposes. Former statistics counted the harvested fish, which included fish for restocking, too. Re-stocking should not be underestimated in case of volume and value. Further, the official statistics have been criticized for not being valid at all (Klinkhardt 2014). Consultations with researchers from federal fisheries research stations confirm that the validity of data is still a problem. In particular, the cultured area and aquaculture production for carp and trout seems to be underestimated in several regions (Oberle 2015, Rösch 2015). For instance, a study undertaken by the Bavarian Institute for Fisheries, Department of Carp Aquaculture and the University of Erlangen compared official statistics with the results of own local data collection. The study shows that official statistics account for 1 599.02 ha carp pond area in the Aischgrund (Bavaria), while the local control lead to 2 265.05 ha (Oberle 2014). Furthermore, Destatis have introduced thresholds in 2015. Since then, the statistical reports only consider farms >0.3 ha or 200m³. In reducing bureaucratic effort for smallholders this introduction of thresholds is welcomed. Notwithstanding, it leads to the fact, that since 2015 the statistics are not comparable with recent years. However, against all shortcomings of the Destatis production statistics, it is the best available and it provide a value basement of knowledge about Germany's aquaculture sector.

In terms of economic variables for freshwater aquaculture, there is a lack of data due to the fact that the data collection is still voluntary. Thus, economic data for this important segment of German aquaculture is missing. The DCF regulation EU 1004/2017 and the new willingness of political decision makers in Germany to provide data on freshwater aquacultures gives cautious hope to overcome the gap in the close future.

Beside the aforementioned concerns, there is a high difference between the blue mussel production reported by Eurostat and the blue mussel production (harvest) reported in DCF. Eurostat reports 7 822 tonnes for 2015 and 12 755 tonnes for 2016. DCF data reports 13 695 tonnes for 2015 and 22 242 tonnes for 2016. That is a difference of almost 5 000 tonnes or more than 8 500 tonnes! Thereby Eurostat is also not in line with the national statistical office, Destatis, which reported 13 076 tonnes of blue mussels for 2016 and 7 907 tonnes in 2015, but almost. DCF and Destatis volumes base on different methods. Data under DCF are based on landing statistics from the Federal Office of Agriculture and Food (BLE), where the purchaser is obligated to report the bought amount of mussels by law to the BLE; while the German Statistical Office collects the data via questionnaire. Both organisations have been contacted by the author. Unfortunately, the persons in charge could not explain the difference satisfactorily. Anyway, after the consultation of several stakeholders from the blue mussel sector, the data from BLE or from DCF seems to be the more viable. In case of the freshwater aquaculture, the data is comparable between Destatis and Eurostat and FAO, as the source is the same since several years. Please, consider the above mentioned shortcomings and in particular the introduction of thresholds in 2015.

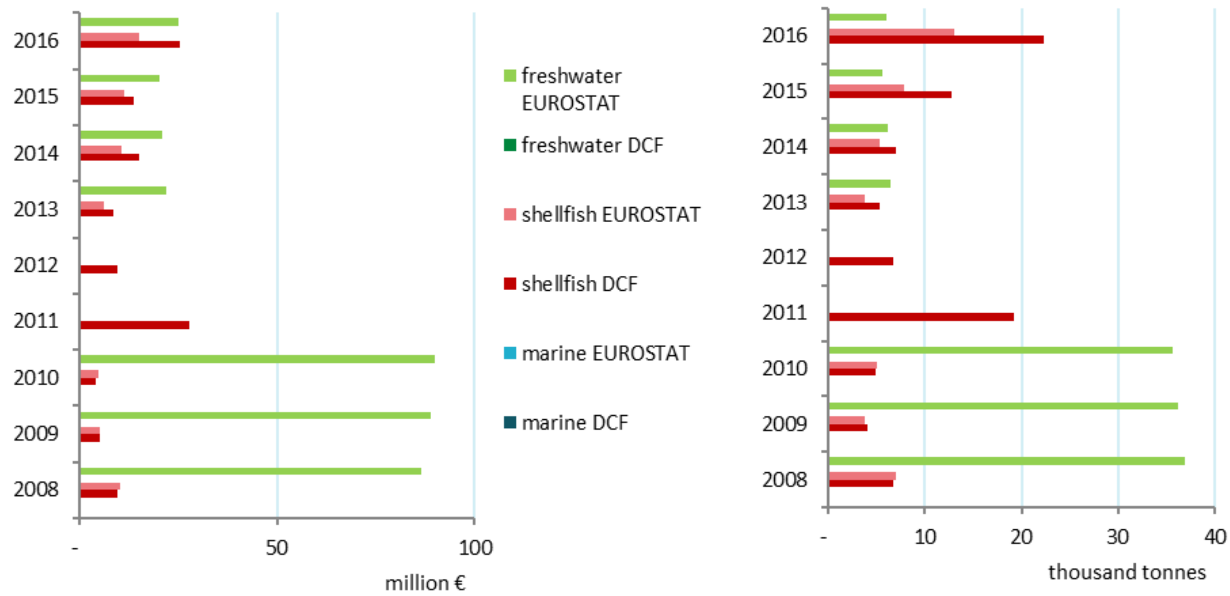


Figure 4.11.5 Comparison of DCF data with EUROSTAT data for Germany 2008-2016

4.12 Greece

4.12.1 Production and sales

According to the data provided by Greece, for 2016, the aquaculture production was 135.2 thousand tonnes representing a value of €583.9 million while for the year 2015 the respective values were 122.9 thousand tonnes with a value of €465.8.

In 2016, there was an increase in production and sales for both aquaculture marine fish and shellfish while a significant production drop of 67% of freshwater fish production led to a 44% drop of sales for that species. Overall, from 2008, aquaculture sales volume and value increased by 17%.

Table 4.12.1 Production and sales for Greece: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/(08-15)
Sales weight (thousand tonnes)	***115.4***	***554.6***	***123.6***	***121.8***	***114.8***	***78.9***	***118.0***	***122.9***	***135.2***	*10%*	*-20%*
Marine	89.5	100.5	101.7	100.5	94.3	76.3	89.2	91.6	105.9	*16%*	*14%*
Shellfish	21.2	22.5	18.0	18.6	17.6	0.0	21.8	22.8	25.7	*13%*	*44%*
Freshwater	3.9	430.9	3.2	1.9	2.2	2.3	6.7	7.5	2.5	*-67%*	*-96%*
Hatcheries & nurseries	0.8	0.7	0.8	0.8	0.7	0.3	0.3	1.0	1.2	*21%*	*78%*
Sales value (million €)	***456.0***	***498.4***	***534.7***	***523.3***	***545.0***	***370.9***	***448.1***	***465.8***	***583.9***	*25%*	*22%*
Marine	353.6	395.7	429.0	420.9	448.1	337.7	404.1	420.0	543.2	*29%*	*35%*
Shellfish	9.0	10.9	8.6	8.6	7.1	0.0	8.6	8.9	10.3	*16%*	*33%*
Freshwater	13.2	11.5	11.5	8.8	7.4	6.7	6.1	19.5	11.0	*-44%*	*4%*
Hatcheries & nurseries	80.2	80.3	85.6	85.0	82.4	26.5	29.3	17.4	19.4	*12%*	*-68%*

Source: EU Member States DCF data submission

4.12.2 Industry structure and employment

Almost 18% of the aquaculture companies in Greece are large capital companies (SA and Ltd enterprises), responsible for 80% of total aquaculture product sales. Those enterprises represent mainly the marine finfish aquaculture sector while the freshwater and shellfish aquaculture sector is mainly comprised of small family enterprises.

Table 4.12.2 Structure of the Greek aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/ (08-15)
Structure (number)											
Total enterprises	*1,038*	*1,020*	*1,017*	*1,017*	*1,051*	*54*	*248*	*558*	*642*	*15%*	*-14%*
<=5 employees	721	705	704	704	738	21	187	327	383	*17%*	*-25%*
6-10 employees	221	219	217	217	217	9	22	87	91	*5%*	*-40%*
>10 employees	96	96	96	96	96	24	39	144	168	*17%*	*96%*
Employment (number)											
Total employees	*6,073*	*5,983*	*6,032*	*5,559*	*4,900*	*2,901*	*5,129*	*3,799*	*3,986*	*5%*	*-21%*
Male employees						2,318	4,280	3,218	3,579	*11%*	*9%*
Female employees						583	849	581	407	*-30%*	*-39%*
FTE						2,878	4,640	3,234	3,482	*8%*	*-3%*
Male FTE						2,303	3,832	2,867	3,091	*8%*	*3%*
Female FTE						575	808	367	391	*7%*	*-33%*
Indicators											
FTE per enterprise						53.3	18.7	5.8	5.4	*-7%*	*-79%*
Average wage (thousand €)						19.1	21.4	16.5	16.2	*-2%*	*-15%*
Labour productivity (thousand €)						31.2	25.6	49.3	60.3	*22%*	*70%*

Source: EU Member States DCF data submission

Total employment in the Greek aquaculture sector is estimated at 3 786 employees in 2016 or 3 482 in FTE terms and 3 799 employees in 2015 or 3 234 in FTE. Male employees dominate the aquaculture sector as they correspond to 87.9% of the sector for 2016 and 82% for 2015.

Female employees are usually employed in marine hatcheries and packing units as well as in companies' secondary activities like de-shelling freezing and processing and account for 12% of the employment in the sector for 2016, 18% for 2015 and 11% for both years in FTE terms.

There is a significant drop of total employees' number for the years 2015 and 2016 compared to 2014 and especially to 2008-2012 years; however, the reduction may be attributed to the late years' demonstration of employment exclusively in aquaculture activity and not including any secondary activities personnel.

4.12.3 Economic performance

For the years 2008 to 2012, no economic variables are provided by Greece. For 2013, due to the fact that the data was acquired in a very short time period, they are inconsistent and do not account for the population of the enterprises.

For the year 2016 the Greek aquaculture sector produced €588.5 million of income generated mostly from turnover (99%), subsidies (€1.7 million) and other income (€3 million). For the year 2015, aquaculture generated €476.7 million mainly from turnover (98%) and the rest respective income values were €10.3 million other income and €0.6 million from subsidies. The respective operating costs for each year were €432.2 million for 2016 and €370 million adequately covered in both years by the income generated.

Debt has dropped significantly during the last 3 years due to loans renegotiations and due to company acquisitions procedures. Still, for 2015 debt accounts for 147% of the generated income while in 2016 it amounted to 74% of the income generated.

According to the net profit indicator, the sector generated profits in both 2015 and 2016 after continuous year losses. Also, the year 2016 is the first one that produces net investments that surpass the respective depreciation of capital (€11.4 million net investments to €10.6 million capital depreciation). Study of those indicators in following years will prove if this shift towards investments is circumstantial.

4.12.4 Main species produced and economic performance by segment

In both years 2016 and 2015, Gilthead sea bream comprised the major part of Greek aquaculture sector accounting for 47% of production value and 39% of the Greek aquaculture production volume in 2016 while in 2015 the respective values were 43% of production value and 51% of the production volume. In second place, the European sea bass, accounted for 36% of the production volume and 45% of the production value in 2016 while in 2015 the respective numbers were 30% of the production volume and 39% of the production value. Mediterranean mussel, although represents a significant part in terms of volume, producing 19% of the total aquaculture production volume in both 2016 and 2015, generated only 2% of the total production value also in both years, as a result of the relatively low unit price of mussels. Other fresh water fish and other species contribute 6% to both the production volume and to the production value for the year 2016 while in 2015 it produced respectively 8% in both volume and value.

Table 4.12.3 Economic performance of the Greek aquaculture sector: 2008-2016

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	*% of total income*	Change 2016-15	Development 2016/(2008-15)
Income (million €)												
Turnover	456.0	498.4	534.7	523.3	545.0	370.9	613.3	465.8	583.9	*99%*	*25%*	*17%*
Other income						38.3	63.7	10.3	1.7	*0%*	*-84%*	*-96%*
Subsidies	4.5	8.0	0.0	0.0		0.0	3.3	0.6	3.0	*1%*	*405%*	*27%*
Total income	*460.5*	*506.4*	*534.7*	*523.3*	*545.0*	*409.2*	*680.3*	*476.7*	*588.5*	*100%*	*23%*	*14%*
Expenditures (million €)												
Wages and salaries						54.4	97.5	51.3	52.6	*9%*	*3%*	*-22%*
Imputed value of unpaid labour						0.6	1.9	2.1	3.9	*1%*	*86%*	*153%*
Energy costs						9.6	16.5	10.0	6.0	*1%*	*-40%*	*-51%*
Repair and maintenance						5.2	8.5	9.0	6.9	*1%*	*-23%*	*-9%*
Raw material: Feed costs						134.0	230.7	171.5	229.8	*39%*	*34%*	*29%*
Raw material: Livestock costs						111.7	195.0	27.8	47.5	*8%*	*71%*	*-57%*
Other operational costs						58.8	107.4	98.3	85.5	*15%*	*-13%*	*-3%*
Total operating costs						*374.3*	*657.4*	*370.0*	*432.2*	*73%*	*17%*	*-8%*
Capital Costs (million €)												
Depreciation of capital						14.0	18.7	13.9	10.6	*2%*	*-23%*	*-32%*
Financial costs, net						28.7	45.1	7.4	14.8	*3%*	*100%*	*-45%*
Extraordinary costs, net						3.0	63.8	1.3	0.7	*0%*	*-50%*	*-97%*
Capital Value (million €)												
Total value of assets						594.5	1200.3	1045.7	1088.9	*185%*	*4%*	*15%*
Net Investments						8.5	6.3	5.4	11.4	*2%*	*111%*	*69%*
Debt						547.0	1156.3	701.3	436.9	*74%*	*-38%*	*-45%*
Input & Production (thousand tonnes)												
Raw material: Feed						244.7	273.1	128.4	178.9		*39%*	*-17%*
Raw material: Livestock						0.0		3.2	4.0		*24%*	*148%*
Performance Indicators(million €)												
Gross Value Added						89.9	119.0	159.5	209.9	*36%*	*32%*	*71%*
Operating cash flow						34.9	22.9	106.6	156.4	*27%*	*47%*	*185%*
Earning before interest and tax						20.9	4.2	92.8	145.8	*25%*	*57%*	*271%*
Net profit						-7.9	-40.8	85.3	130.9	*22%*	*53%*	*972%*
Capital productivity (%)						15.1	9.9	15.3	19.3		*26%*	*44%*
Return on Investment (%)						3.5	0.4	8.9	13.4		*51%*	*215%*
Future Expectation Indicator (%)						-0.9	-1.0	-0.8	0.1		*109%*	*108%*

Source: EU Member States DCF data submission

Relatively small quantities of dentex and mullet are produced. Other species like white sea bream, stripped sea bream and common pandora are either produced in small quantities or on experimental production stage. Shellfish production is mainly comprised of mussels and freshwater production is mainly comprised of rainbow trout.

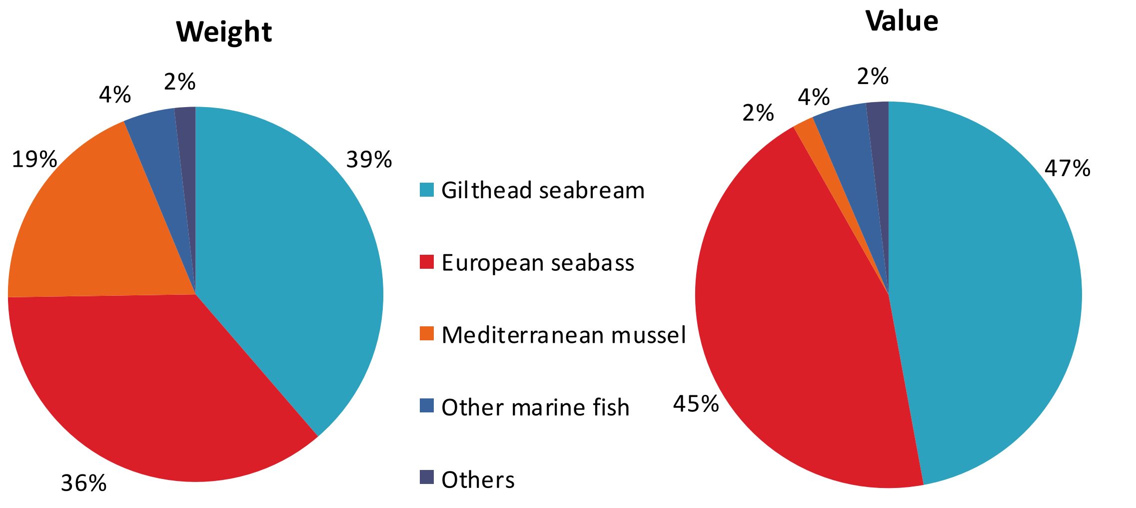


Figure 4.12.4 Main species in terms of weight and value in Greek production: 2016.
Source: EU Member States DCF data submission

Regarding the assets performance per segment, 2016 demonstrated better higher efficiency compared to 2015 in all segments except the marginally less performance of Sea bass & Sea bream Hatcheries & nurseries while the mussel long line segment demonstrated the highest raise of performance.

In FTE per segment terms, for both 2016 and 2015, Sea bass & Sea bream cages employed 70% of the total aquaculture FTE.

Segment 1. Sea bass & Sea bream cages

The segment of Sea bass & Sea bream cages demonstrated for both 2015 and 2016 the biggest sales volumes (respectively 88.7 thousand tonnes in 2015 and 99.9 in 2016), following an increase starting in 2013 with total income of 410.8 million in 2015 and 521.1 million in 2016. Both years show significant net profits (€101.1 million in 2015 and €143.7 in 2016) after losses in both 2013 and 2014. In FTE per segment terms, for both 2016 and 2015, Sea bass & Sea bream cages employed 70% of the total aquaculture FTE (2 252 in 2015 and 2 442 in 2016 FTE).

Segment 2. Sea bass & Sea bream hatcheries and nurseries

The Sea bass & Sea bream hatcheries and nurseries segment sales volumes were one thousand tonnes in 2015 and 1.2 in 2016, a significant increase compared to the 0.3 thousand tonnes for both 2013 and 2014 years with total income of 19.2 million in 2015 and 19.5 in 2016, a significant drop from the two previous years, with 30.2 million and 28.4 million respectively, while also demonstrating losses and negative operating cash flow for both years. In FTE terms the respective number are 187 for 2015 and 182 for the year 2016. The losses are attributed to the fact that most fry volume is used for own consumption from companies that hold aquaculture units of different techniques (i.e. cages and hatcheries nurseries).

Segment 3. Trout on growing

The Trout on growing segment produced 2 thousand for 2015 and 2.1 thousand tonnes for 2016 demonstrating both years net profit of 2.3 million and 3.6 million respectively. Total income for the two years was 5.8 million and 6.9 million respectively. They employed 124 in 2015 and 120 in 2016 in FTE terms

Segment 4. Mussel long line

The mussel long line segment produced a sales volume of 22.8 thousand tonnes in 2015 and 25.7 in 2016 demonstrating net profit of 4.8 million and 6.9 million respectively. The segment's total income for 2015 was 8.9 million and 10.3 million for 2016. Employment for 2015 was 507 and for 2016 566 in FTE terms with no available data for 2013 and 2014.

Table 4.12.5 Economic performance of main aquaculture segments in Greece: 2010-2016 (in million €).

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	% of total income	Change 2016/15	Development 2016/(2008-15)
Sea bass & Sea bream cages												
Total income						379.0	389.9	410.8	521.1	100%	27%	33%
Gross Value Added						83.3	41.8	155.9	204.5	39%	31%	118%
Operating cash flow						32.3	-20.5	114.8	160.4	31%	40%	280%
Earning before interest and tax						19.3	-36.2	106.1	152.5	29%	44%	413%
Net profit						-7.3	-68.2	101.1	143.7	28%	42%	1578%
Total sales volume (thousand tonnes)	85.6	96.5	97.0	96.7	90.6	76.3	85.1	88.7	99.9		13%	12%
Mussel Long line												
Total income							8.5	8.9	10.3	100%	16%	18%
Gross Value Added							0.9	8.6	10.1	98%	17%	111%
Operating cash flow							-0.4	4.8	6.9	67%	45%	220%
Earning before interest and tax							-0.8	4.8	6.9	67%	45%	248%
Net profit							-1.5	4.8	6.9	67%	45%	322%
Total sales volume (thousand tonnes)	21.2	22.3	18.0	18.6	17.6		21.6	22.8	25.7		13%	26%
Other freshwater fish combined												
Total income							6.1	13.7	4.1	100%	-70%	-59%
Gross Value Added							0.7	10.4	1.3	32%	-87%	-76%
Operating cash flow							-0.3	8.6	0.0	-1%	-100%	-100%
Earning before interest and tax							-0.6	7.9	-0.6	-14%	-107%	-116%
Net profit							-1.1	7.9	-0.6	-16%	-108%	-119%
Total sales volume (thousand tonnes)							6.7	5.5	0.4		-93%	-93%
Other marine fish cages												
Total income							9.2	18.2	26.6	100%	46%	94%
Gross Value Added							1.0	-4.5	4.0	15%	188%	324%
Operating cash flow							-0.5	-5.2	3.3	12%	163%	216%
Earning before interest and tax							-0.8	-6.9	3.3	12%	147%	184%
Net profit							-1.6	-7.7	1.9	7%	125%	141%
Total sales volume (thousand tonnes)	3.8	3.9	4.7	3.8	3.7		2.3	2.9	6.0		108%	67%
Trout on growing												
Total income								5.8	6.9	169%	19%	19%
Gross Value Added								4.2	4.8	116%	15%	15%
Operating cash flow								2.4	3.7	90%	56%	56%
Earning before interest and tax								2.3	3.6	88%	58%	58%
Net profit								2.3	3.6	88%	59%	59%
Total sales volume (thousand tonnes)								2.0	2.1		3%	3%
Sea bass & Sea bream Hatcheries & nurseries												
Total income						30.2	28.4	19.2	19.5	475%	1%	-25%
Gross Value Added						6.6	3.0	-15.1	-14.7	-359%	2%	-721%
Operating cash flow						2.6	-1.5	-18.7	-17.9	-437%	4%	-205%
Earning before interest and tax						1.5	-2.6	-21.4	-20.0	-487%	7%	-167%
Net profit						-0.6	-5.0	-23.0	-24.6	-598%	-7%	-158%
Total sales volume (thousand tonnes)	0.8	0.7	0.8	0.8	0.7	0.3	0.3	1.0	1.2		21%	81%

Source: EU Member States DCF data submission

In the figure below only the years with fully segmented data are displayed.

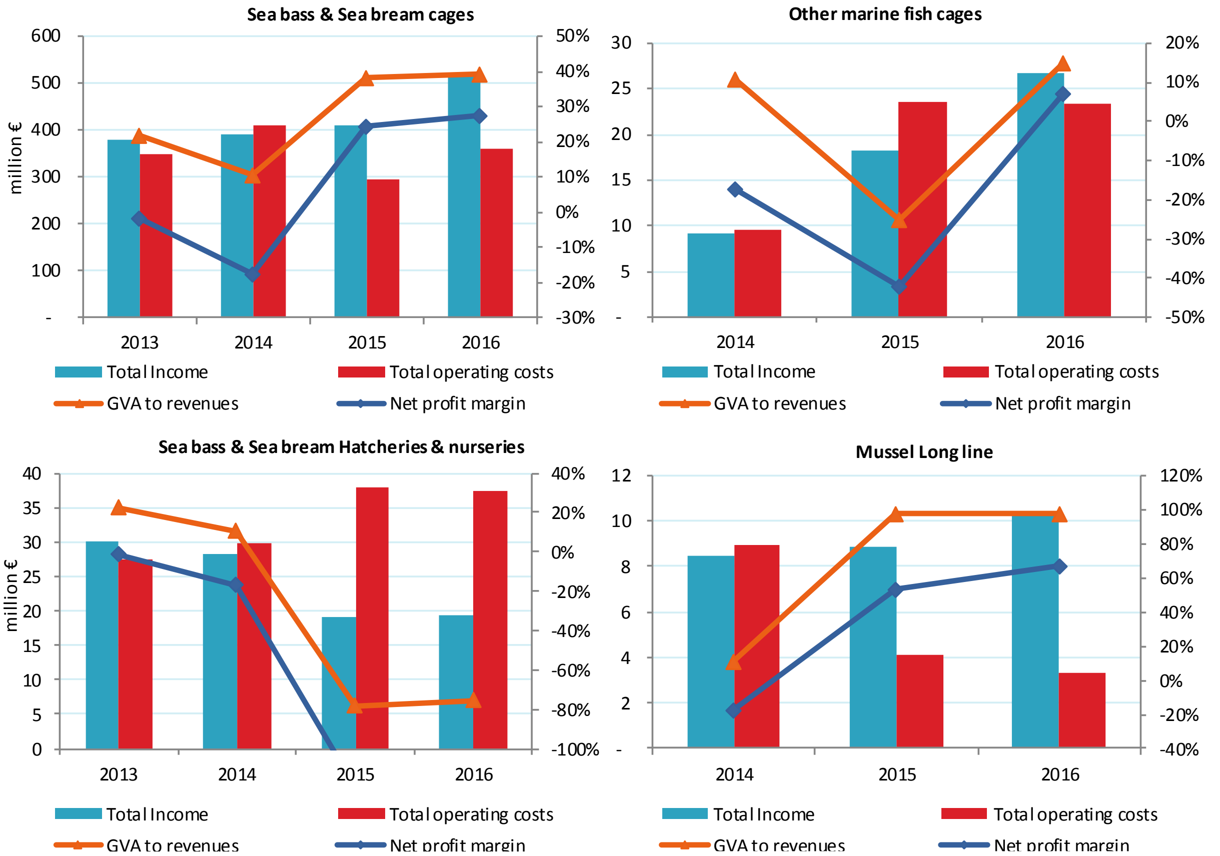


Figure 4.12.6 Economic performance indicators for the main segments in Greece: 2010-2016

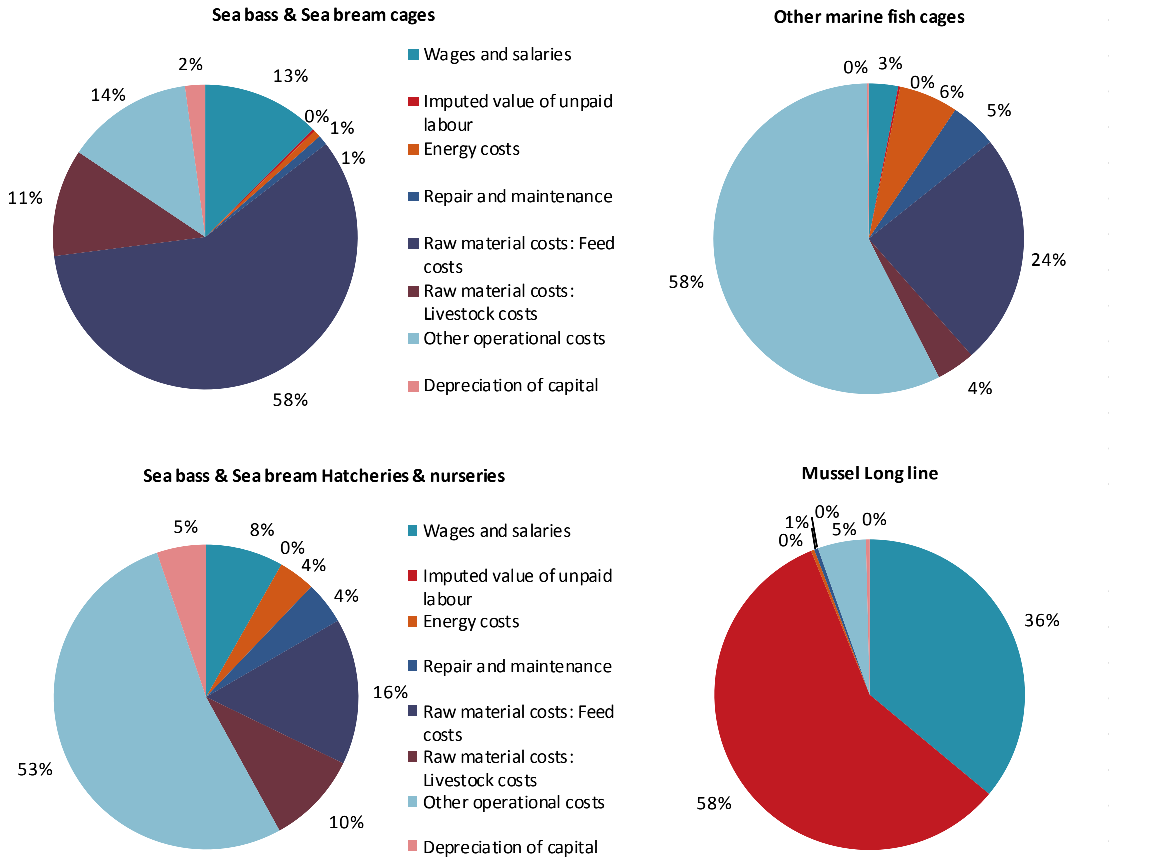


Figure 4.12.7 Cost structure of the main segments in Greece: 2016.

Segment 5. Other marine fish cages

The other marine fish cages segment demonstrated net profit in 2016 that amounted to 1.6 million while in 2014 and 2015 presented losses despite the continuous increase of total income for all three years, as from 9.2 million in 2014 and 18.2 in 2015 it reached 26.6 million in 2016. In 2016 it doubled its total sales volume (6 thousand tonnes in 2016 up from 2.9 thousand tonnes in 2015. In FTE terms, the segment's employment was 48 for both 2015 and 2016. There is no available data for 2013-2014

Segment 6. Other fresh water fish combined

For the Other fresh water fish combined segment, a significant drop in sales in 2016 (0.4 thousand tonnes) compared to previous two years, (6.7 thousand tonnes in 2014 and 5.5 in 2015) led to a drop of the total income to 4.1 million after a great increase in 2015 (13.7 million up from 6.1 million in 2014), presenting therefore in 2016 losses after the profitable 2015. The respective FTE numbers for the segment are 112 for 2015 and 111 for 2016. There is no data for 2013-2014.

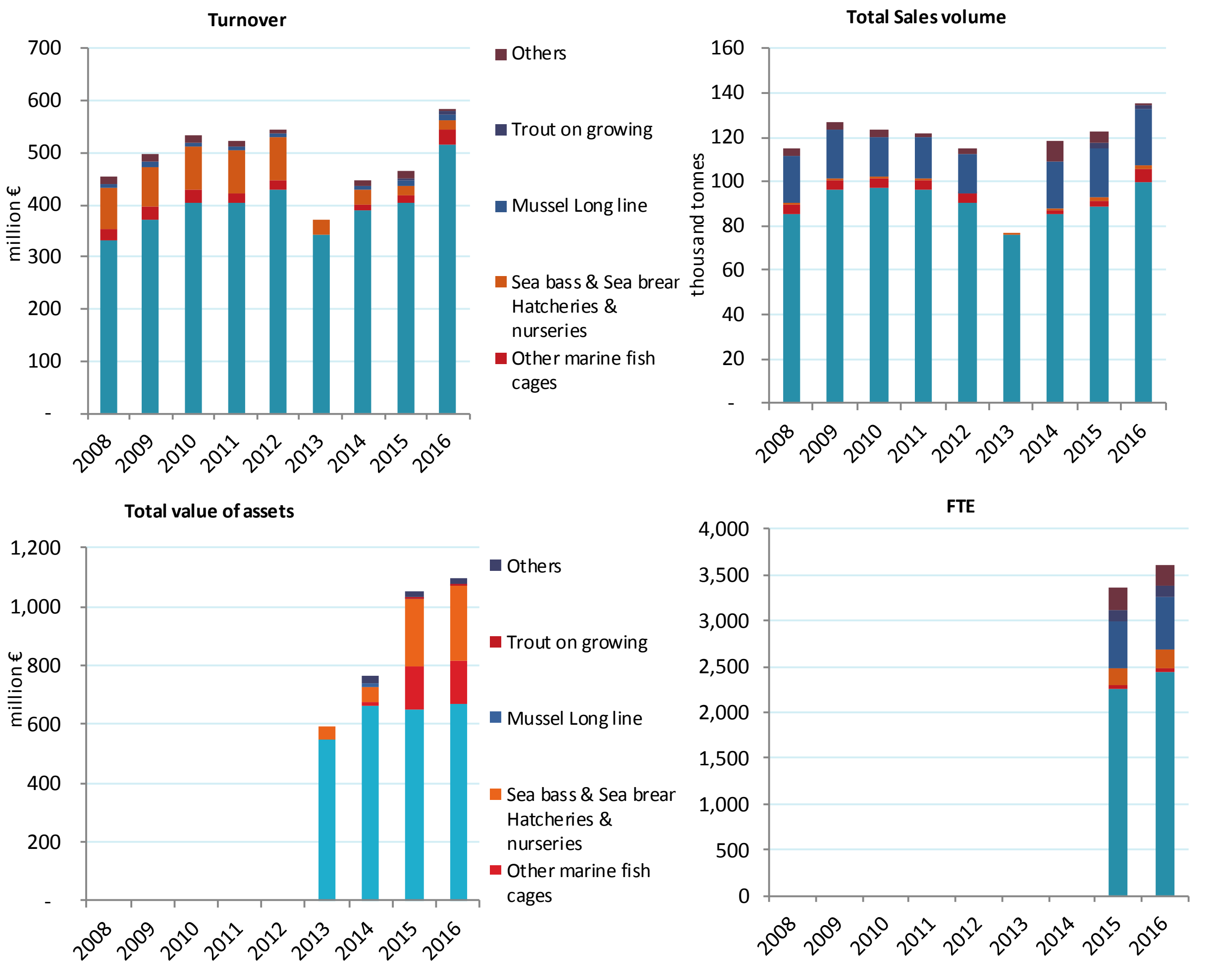


Figure 4.12.8 Structural development Greek aquaculture sector: 2008-2016.
Source: EU Member States DCF data submission

4.12.5 Trends and triggers

Current production trends and main drivers

Starting at 2014, Greek aquaculture production volume demonstrates a continuous increase reaching 135.2 thousand tonnes for 2016 with a parallel increase of marine fish sales, as it was expected based on the effect of the higher prices (and thus profit margins) received by the producers during 2014 and 2015. The production increase is expected to continue due to the restructuring of debt and bank loans and the changes of management for the main Greek production companies (due to acquisition of companies during 2015 and 2016 and scheduled company acquisitions in 2017 and 2018, with pending approval of takeover)

As for the mussel production, a small increase of both production volume and sales is also expected to continue because of the increase of net profit. Freshwater expansion is mainly restricted by the unavailability of suitable space in Greece.

Market structure

The first producer organisation for the sea bream and sea bass aquaculture was formed in Greece in 2016 and during 2018 it covers a rather large share of the production (>70%).

The Greek sea bass and sea bream production sector is still (2018) undergoing a consolidation phase. The two major production companies in Greece were acquired in 2018 (subject to the pending decision of the EU competition authorities) by a capital investment fund which also controls the third largest production company in Greece and production companies in Spain, forming probably the largest production group in the EU. Nevertheless, it seems that other capital investment funds are also interested in concentrating production both in Greece and other EU countries thus we expect at least two large production groups to be formed in the EU.

While export subsidies in non EU countries seem to have been eliminated, still the playing field is not levelled for the EU sea bass and sea bream producers. Non EU production is not regulated to the same EU extend and producers do not need to maintain the same production standards (thus allowing for lower production costs). Nevertheless, both EU and non EU producers compete in the same markets.

As the price of sea bream is diminishing in 2018, we do not expect a rise in the production for the next 2-3 years. Contrary, subject to juvenile availability, we expect rise in the production of sea bass.

Issues of special interest

Certain structural problems of the operating aquaculture sector prevent the desired progress hoped to be achieved by the company holders. Some of those problems, most of them expressed by the same holders are:

Lack of liquidity for most aquaculture enterprises as a result of the inability to acquire new bank loans for purchasing raw materials and meeting direct company needs and even to acquire letters of guarantee necessary for exports procedures

Significant increase in production costs and overheads (customs clearance costs, certification costs due to participation attempts in subsidies-funding programs and rise of prices for auxiliary materials and fuels, resulting in increased transport costs for aquaculture products)

Time-consuming aquaculture licensing procedures, as the average time for completing a licensing procedure, depending on the area and type of farming, is about 25 months. This time-consuming process and high tax costs act as a disincentive for young entrepreneurs who want to be active in the aquaculture industry and they may lead to the choice of migration for existing Greek companies.

An important problem is the non-designation to date of Areas of Organized Aquaculture Development (AOAD or POAY in Greek). The term refers to marine areas which fulfil specific characteristics for the development of aquaculture, i.e. organized marine areas within which aquaculture units will be located, preventing operation of non-approved aquaculture units.) This fact makes it difficult for new aquaculture units to be licensed, to relocate old units or even to deploy units in operation.

The industry operates under a partial monopoly status as a significant percentage of the units belong to a small number of companies.

Outlook for 2017 and 2018

Thus, in the short run, rise of the production and rise of investment is expected for the Greek aquaculture. The Greek banks, as present major shareholders in the aquaculture are expected to transfer the shares to new investors. Further consolidation of the sea bass and sea bream sector is also likely, subject to authorization of the competition authorities. On the long run, more EMFF funds directed toward research and innovation (rather to the renovation of production facilities) are needed for the development of the sector.

Further consolidation of the mussel sector is expected. Nevertheless, a considerable rise of the production is not expected if key issues of the mussel aquaculture in Greece are not addressed. These key issues include the identification of new suitable areas for mussel aquaculture, talking with unlicensed production, the establishment of integrated areas for aquaculture development and the establishment of early warning systems related to climatic factors.

4.12.6 Data Coverage and Data Quality

Data quality

No specific survey for DCF data collection was conducted in Greece for the period of 2008 to 2012; hence the lack of economic variables for those years, while in 2013, due to lack of budget authorization, an early attempt was made to demonstrate a part of the Greek aquaculture industry and the data analysis was limited to the sea bass & sea bream cages segment since it is the main aquaculture activity. Throughout 2014 - 2016, a more complete survey for DCF data collection took place according to Greece's National Proposal for Fisheries Data Collection.

It has to be pointed out that the sample, population and achieved sample rate values of Greece's aquaculture data for all years, 2008-2016 are referred to aquaculture units (population 698 for 2016, where 642 responded to the data collection) although those units belong to less than half enterprises (the 642 units that responded belong to 302 enterprises). The main reason for keeping the units as the base of the survey is that Greece's national authorities monitor the aquaculture sector as units for health and environmental inspections and controls and because the companies that hold more than one aquaculture units with different activity (i.e. cages, hatcheries and nurseries) are unable or unwilling to providing the volume and values that are segmented, and cannot or will not apply the production cost and employment segmentation on each segment so the survey asks the required data from the units. The population segmentation is also applied on the number of units.

In order to avoid this issue, it is recommended that the segmentation should be minimized to the main aquaculture product categories and main aquaculture activity so that the categorization will be based on the aquaculture enterprises and not on the units, i.e. one segment Sea bass and Sea bream combined in case of both cages and hatcheries nurseries etc. Therefore, the different aquaculture techniques-segments operating under a single company shall be reported as one main segment of the main activity, especially if the case of the secondary operating segment's purpose is own consumption (i.e. company's hatchery provides fry for the company's cages segment). That is the main reason why the segment of Sea bass and seas bream hatcheries and nurseries demonstrates losses despite a significant production, as it is described in the section of economic performance by segment. Volumes of the parallel segments may still be reported but economic analysis should focus on the enterprises' economic activity.

Data availability

For the year 2015, the data collection process included the mailing and completion of a questionnaire by companies in aquaculture sector. On a second stage, there were onsite visits to the companies in order to acquire more detailed information for further segmentation. In cases of

SA and LTD enterprises, there was an extra processing of the published financial statements in order to be crosschecked the information that was provided in questionnaires. Additionally, several data acquired from the records of the Hellenic Ministry of Rural Development and Food. For 2016, basic source for the collection of economic data for the was the Integrated Monitoring System of Fisheries Activities (OSPA) fully operating in 2017 for the first time and a survey was used for the confirmation and supplementation of the collected aquaculture data. The majority of the required economic data were derived from the processing of the balance sheets and financial statements of the companies, however, the socio-economic data needed (employment by gender etc.) were provided by on-site visits, interviews, financial records and balance sheets comment sections.

Differences in DCF data compared with other official data sources

As it is aforementioned, Greek DCF data collection is gathered accordingly to the Greek National Proposal and it requires the cooperation of aquaculture companies, especially during on site interviews or submission of questionnaires. Heavily segmented required data, especially about production cost and employment, is generally treated at least hesitantly by the companies and units. Issues like confidentiality, missing or partially aggregated data can occur especially in smaller companies, leading to unreported data. The above issues are mainly responsible for divergences between Greek DCF and EUROSTAT data. Given the current structure of the sector, the author suggests that all the enterprises in the marine finfish sector to be treated as one segment under DCF. This will reduce the burden to the reporting enterprises and will produce better quality of data. Some variables such as the number of enterprises producing new species, the volume and value of the new species (other than sea bass and sea bream) produced are enough in order to highlight the trend for these species.

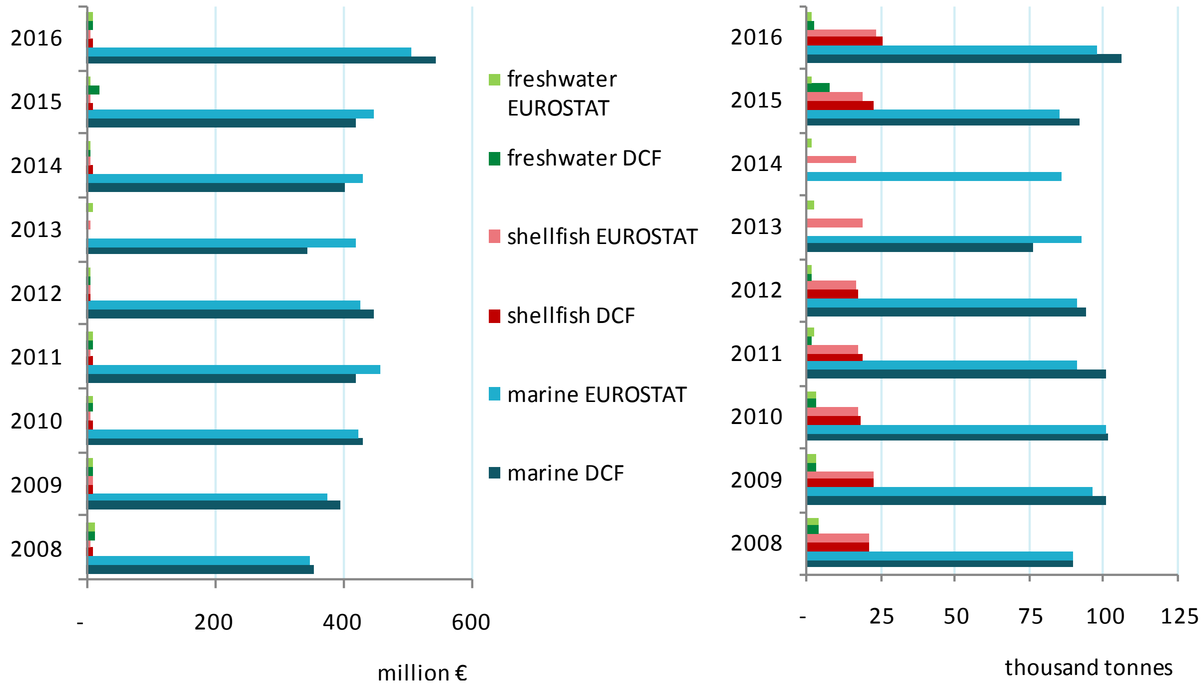


Figure 4.12.9.Comparison of DCF data with EUROSTAT data for Greece: 2008-2016

4.13 Hungary

Production volume and value

The Hungarian aquaculture sector produced 17.3 thousand tonnes of fish in 2015. This production was valued at about €30.6 million (EUROSTAT, 2018). Hungary produces no marine or shellfish aquaculture.

A growth in sales weight of 13% was observed from 2014 to 2015. This growth raised the total sales of 15.4 thousand tonnes to 17.3 thousand tonnes, observing the highest value in the analysed period, and from €29.5 million to €30.6 million.

Despite the significant increase in production volume, the sales value only increased 4% in 2015.

Table 4.13.1 Production and sales for Hungary: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	Change 14-15	Develop. 2015/(08-14)
Production weight (thousand tonnes)	***15.0***	***14.2***	***13.6***	***15.5***	***14.6***	***14.4***	***15.4***	***17.3***	***13%***	***18%***
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Freshwater	15.0	14.2	13.6	15.5	14.6	14.4	15.4	17.3	*13%*	*-100%*
Production value (million €)	***30.4***	***26.5***	***27.2***	***30.3***	***29.9***	***25.6***	***29.5***	***30.6***	***4%***	***-100%***
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Freshwater	30.4	26.5	27.2	30.3	29.9	25.6	29.5	30.6	*4%*	*-100%*
Hatcheries & nurseries (million units)	***70***	***46***	***0***	***0***	***0***	***0***	***0***	***0***	***0%***	***-100%***
Eggs	1	0	0	0	0	0	0	0	*0%*	*-100%*
Juveniles	69	46	0	0	0	0	0	0	*0%*	*-100%*

SOURCE: EUROSTAT

Main segments

According to available EUROSTAT statistics, the common carp was the main specie produced by the Hungarian aquaculture sector, representing 62% in terms of weight and value of total production in 2015. Due the price depreciation, in spite of 4% growth in weight from 2014 to 2015, the valued of production have decreased by 6%.

The second most important specie is the North African catfish with 16% of the total weight and 17% of the total value. Concerning this segment, it matters to state that production have increased 30% in volume and 23% in value in the last year.

Silver carp represents 6% of production value and 13% in volume and registered an increase of 51% in volume and 48% in value in 2015.

Freshwater fishes *nei* is the fourth segment with a production that represents 4% in volume having observed an increase of 14% in value and 16% value from 2014 to 2015.

Figure 4.13.1 Main species in terms of weight and value in Hungarian production: 2015.
Source: EUROSTAT

Aquaculture prices have decreased from 2014 to 2015, for all the main species.

The common carp price in Hungary was 1.77 €/Kg in 2015. The price of North African catfish was 1.89 €/Kg, silver carp 0.79 €/Kg, grass carp 1.64 €/Kg, and for Wels catfish it was 4.36 €/Kg in 2015.

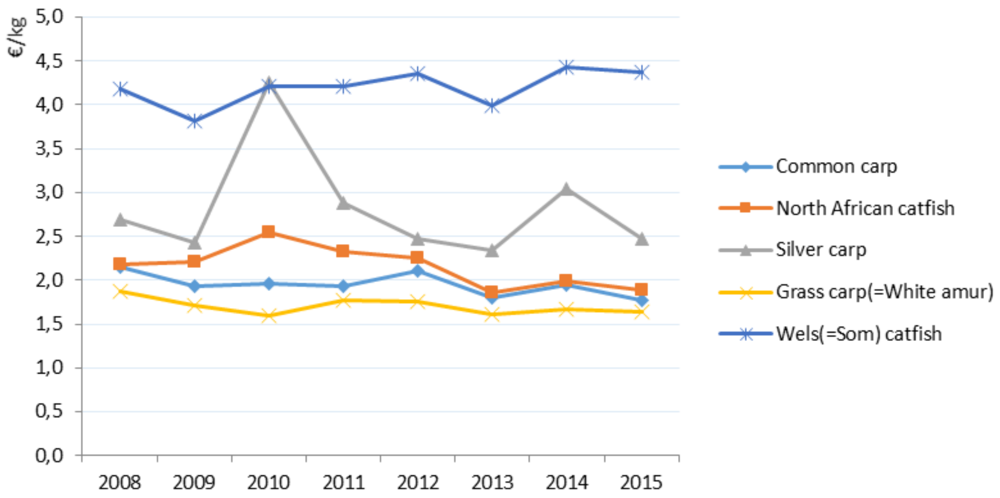


Figure 4.13.2 Average prices for the main species produced in Hungary: 2008-2015.
Source: EUROSTAT

4.13.1 Data Coverage and Data Quality

Hungary is a landlocked country producing only freshwater aquaculture products. The freshwater data collection is not mandatory under the DCF and landlocked countries are therefore not requested to provide economic data for this report.

4.14 Ireland

4.14.1 Production and sales

Table 4.14.1 indicates an overall sales volume recovery close to 2008 levels, while sales total value has reached a new high of €167.7 million in 2016. The marine finfish and shellfish segments have driven this upward trend. Freshwater finfish overall has declined in volume and value output, largely due to the wind-down of perch culture. Freshwater Trout culture, though small at just over 700 tonnes, is relatively secure in a home niche market.

Table 4.14.1 Production and sales for Ireland: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/ (08-15)
Sales weight (thousand tonnes)	***45.0***	***47.4***	***46.7***	***44.8***	***36.2***	***34.7***	***31.7***	***40.1***	***44.0***	*10%*	*8%*
Marine	9.2	12.3	15.9	12.5	12.4	9.4	9.7	13.5	16.7	*24%*	*41%*
Shellfish	33.9	33.6	29.4	30.8	22.7	24.1	20.9	25.6	26.4	*3%*	*-5%*
Freshwater	1.8	1.4	1.2	1.3	0.8	1.0	0.9	0.8	0.7	*-15%*	*-37%*
Hatcheries & nurseries	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	*13%*	*19%*
Sales value (million €)	***94.3***	***106.6***	***122.5***	***128.5***	***130.3***	***117.7***	***116.3***	***148.6***	***167.7***	*13%*	*39%*
Marine	47.1	65.4	77.6	74.2	75.7	56.6	58.8	92.3	106.0	*15%*	*55%*
Shellfish	39.2	34.6	38.6	47.4	47.3	55.5	52.2	51.2	57.0	*11%*	*25%*
Freshwater	6.4	4.8	4.4	4.3	2.8	3.3	3.1	2.7	2.0	*-25%*	*-49%*
Hatcheries & nurseries	1.5	1.9	2.0	2.6	4.6	2.3	2.2	2.4	2.6	*10%*	*-11%*

Source: EU Member States DCF data submission

4.14.2 Industry structure and employment

The structure of Irish aquaculture has largely remained unchanged with a modest overall increase in Production units to 289 in 2016 from 277 in 2014. The increase is in units employing 6-10 and more than 10 persons with a slight decrease in the <=5 category for the period 2015-16 (table 4.14.2). The increases have occurred principally in the off-bottom oyster segment (8.4) where small operators are being licenced and are in start-up phase. In other sectors, amalgamations are occurring and in all sectors sole traders are giving way to limited companies. The amalgamations are being driven by a mix of home and outside investment. The rope mussel and trout segments are being gradually reorganised by Irish companies. The bottom mussel production sites have been accessed to a large extent, by Dutch businesses while French businesses continue going into partnership with Irish oyster operations and acquiring their own Irish sites. The structure of the tiny on-growing Freshwater trout segment (2.2) remains static at 4 units but may amalgamate farther. Other segments will cease altogether or shrink farther, creating a need to farther amalgamate compatible minor segments as confidentiality issues make reporting on the original segmentation impossible.

Employment has increased overall, mainly driven by the oyster off-bottom segment (8.4) and by the salmon on-growing in cages segment (1.4). Employment has declined in the mussel segments (7.2 and 7.3) and in other minor segments. Mean employment profile per enterprise remains stable with an unchanging mean FTE. Labour productivity has increased significantly for the last 5 years, with an 11% increase from 2015 to 2016. The average wage has surprisingly come down, between 2015 and 2016, though this figure may be the result of a suspected under-estimation of the salmon segment 'wages and salary' for 2016.

The ratio between male and female workers has shifted in favour of female workers who increased in number by 27% to 150 persons (up 17% to 78 FTEs) in 2016. The workforce remains mainly male dominated.

Table 4.14.2 Structure of the Irish aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/ (08-15)
Structure (number)											
Total enterprises	*304*	*303*	*302*	*292*	*279*	*283*	*277*	*279*	*289*	*4%*	*0%*
<=5 employees	233	232	229	209	191	198	197	200	194	*-3%*	*-8%*
6-10 employees	41	41	43	52	62	58	49	48	61	*27%*	*24%*
>10 employees	30	30	30	31	26	27	31	31	34	*10%*	*15%*
Employment (number)											
Total employees	*1,972*	*1,952*	*1,715*	*1,748*	*1,708*	*1,840*	*1,821*	*1,830*	*1,948*	*6%*	*7%*
Male employees	1,809	1,807	1,569	1,605	1,571	1,716	1,692	1,713	1,798	*5%*	*7%*
Female employees	163	145	146	143	137	124	129	118	150	*27%*	*9%*
FTE	1,287	976	952	958	956	956	941	983	1,027	*4%*	*3%*
Male FTE	1,220	908	878	875	887	891	871	917	950	*4%*	*2%*
Female FTE	67	68	74	84	69	66	70	67	78	*17%*	*10%*
Indicators											
FTE per enterprise	4.2	3.2	3.2	3.3	3.4	3.4	3.4	3.5	3.6	*1%*	*3%*
Average wage (thousand €)	19.9	28.1	29.8	26.7	42.2	26.0	31.9	32.9	28.5	*-13%*	*-4%*
Labour productivity (thousand €)	21.5	34.0	48.5	55.6	63.4	32.6	52.2	62.4	69.2	*11%*	*49%*

Source: EU Member States DCF data submission

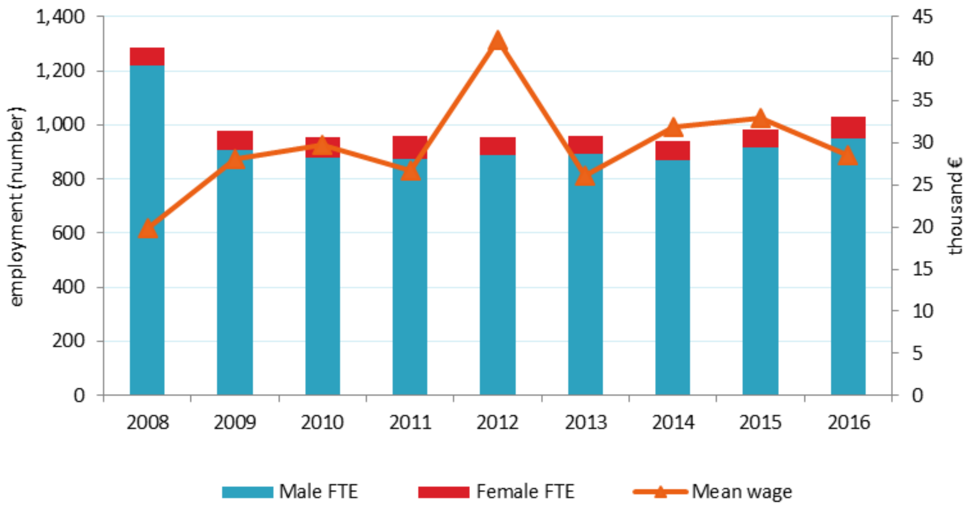


Figure 4.14.1 Employment trends for Ireland: 2008-2016.
Source: EU Member States DCF data submission

Figure 4.14.1 depicts a fairly stable national FTE and a fluctuating mean wage. The mean wage recorded of €28 500 is broadly representative for 2016, mainly in the larger businesses though less so, if at all in the smaller shellfish ones and those of the minor segments. In the case of smaller operations, wage provision may come at the loss of any drawings from turnover taken by the owner-directors who, along with family, create the unpaid labour value in some shellfish segments. A possible under-estimate in the wages and salary for on-grown salmon is considered due to the large disparity in cost between 2015 and 2016. Nevertheless, mean wages in the high €20 thousands is still a reasonable national level estimate.

Figure 4.14.2 shows the challenging year 2013 where total operating costs almost outstripped income and the improving margins from 2014 to 2016. Apart from the 2013 setback, labour productivity has steadily improved from 2008 to 2016.

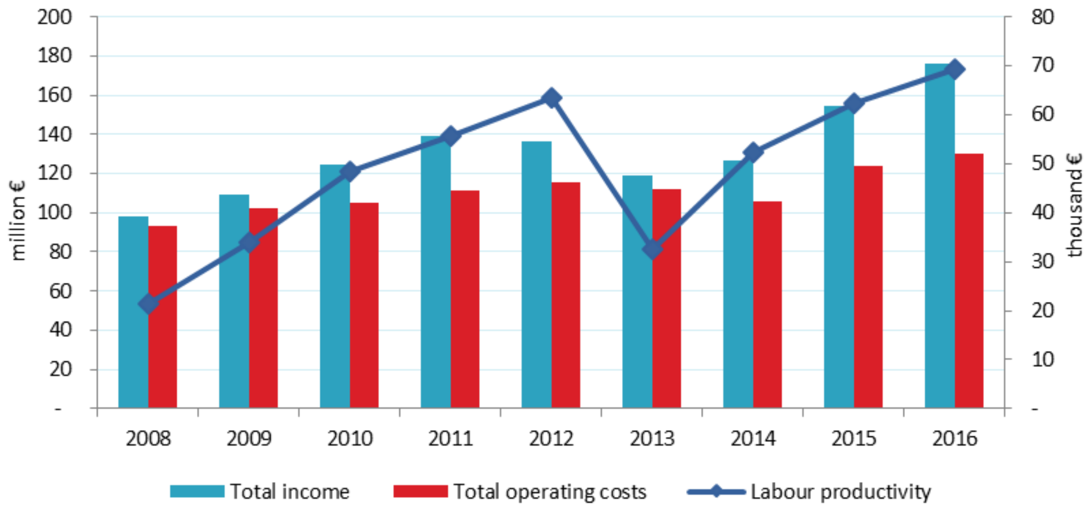


Figure 4.14.2 Income, costs, wages and labour productivity trends for Ireland: 2008-2016.
Source: EU Member States DCF data submission

4.14.3 Economic performance

The performance of Irish aquaculture has improved during 2015 and 2016 from a performance trough in 2013 -14 and is reflected in the indicators of table 4.14.3. The main 4 segments of on-grown caged salmon, off-bottom (Gigas) oysters and the mussel segments drove the overall performance recovery, while the minor segments remained static or declined.

In table 4.14.3 sectoral expansion is indicated in terms of turnover increase with attendant increase in costs generated such as 'Other operational costs', 'livestock' and 'feed' input. The latter have steadily increased while other costs such as wages and salaries, energy, repair and maintenance costs have shown some fluctuation. 2015 was a year of extraordinary costs recorded within the salmon segment, though this may reflect business restructuring, rather than any natural disaster event. Sectoral expansion is also indicated by a steady rise in total assets debts and net investments.

A number of challenges particular to each sector brought on extra ordinary costs in 2014. Poor weather conditions leading to poor growth, stress and disease induced mortality had hit the oyster sector hard. Algal blooms, leading to bay closures to harvesting, led to large scale losses of rope mussels as these fall off as the un-harvested lines grow too heavy. The stock falls to the bottom where it is lost to starfish and crabs. The salmon industry production was curtailed by the continuing effects of the parasite ADG, particularly affecting the health of smolts. The lack of seed mussel, crippling the bottom mussel industry in certain years, may not be considered an extraordinary cost from the point of view of frequency of occurrence, yet the most recent scarcity in the traditionally reliable Western Irish Sea grounds have led to business closures in this sector.

Production expansion is limited by a number of factors; Availability of licenced ground, raw material access and cost against product value, distance to market (mainly export), potentially diseased input stock, exposed and harsh environment, in comparison to some mainland competitors. In response to this the industry is moving, with State and EMFF funding, towards turning some of these challenges to advantage. The harsh environment is used to highlight the image of a healthy clean lean product from the wild Atlantic. The licencing issue remains so industry is making do with what they have and focussing on quality per unit output. Funding is geared towards 4 pillars; Competitiveness, sustainability, training and innovation. The indicators may show this shift to a certain extent, as well as evidence of a fitter industry emerging with net investment, GVA, EBIT, ROI and FEI indicators all on an upward trend for the period. Access to funding is still limited to those businesses with full licences. The presence of most businesses within or adjacent to Natura 2000 sites means that licence renewals require a slow appropriate assessment process undergone before licence renewal, which is being carried out on a Bay by Bay basis. This is especially tough on those producers at the end of the queue.

The industry profitability margin collectively continues to improve in 2015 and 16 after a dip into the red in 2013 (Fig 4.14.3.

Table 4.14.3 Economic performance of the Irish aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	*% of total income*	Change 2016-15	Development 2016/(2008-15)
Income (million €)												
Turnover	94.3	106.6	122.5	128.5	130.3	117.7	116.3	148.6	167.7	*95%*	*13%*	*39%*
Other income	0.9	1.6	0.6	10.3	5.7	0.2	8.5	4.1	4.3	*2%*	*5%*	*8%*
Subsidies	2.9	0.8	1.0	0.7	0.5	0.8	1.7	1.8	4.3	*2%*	*138%*	*235%*
Total income	*98.1*	*109.0*	*124.2*	*139.4*	*136.5*	*118.7*	*126.5*	*154.5*	*176.3*	*100%*	*14%*	*40%*
Expenditures (million €)												
Wages and salaries	23.7	25.1	27.4	23.5	37.9	23.6	28.3	30.9	27.9	*16%*	*-10%*	*1%*
Imputed value of unpaid labour	1.9	2.3	0.9	2.1	2.4	1.3	1.8	1.5	1.4	*1%*	*-7%*	*-20%*
Energy costs	1.9	1.7	3.3	6.1	10.2	11.1	3.8	4.2	5.0	*3%*	*20%*	*-5%*
Repair and maintenance	7.9	7.7	5.8	7.3	10.6	11.4	7.0	9.4	9.9	*6%*	*5%*	*18%*
Raw material: Feed costs	17.5	28.7	25.5	27.7	22.3	23.5	24.9	20.1	36.2	*21%*	*80%*	*52%*
Raw material: Livestock costs	12.6	10.9	7.6	5.4	13.7	14.6	14.7	28.5	16.9	*10%*	*-41%*	*25%*
Other operational costs	27.5	26.0	34.8	39.0	18.6	26.2	25.2	29.1	33.1	*19%*	*14%*	*17%*
Total operating costs	*93.0*	*102.4*	*105.3*	*111.1*	*115.7*	*111.7*	*105.7*	*123.7*	*130.3*	*74%*	*5%*	*20%*
Capital Costs (million €)												
Depreciation of capital	4.0	4.5	13.3	5.7	8.1	6.9	5.0	9.1	5.7	*3%*	*-37%*	*-19%*
Financial costs, net	1.7	1.4	2.4	0.8	2.1	3.0	6.4	9.0	4.9	*3%*	*-46%*	*46%*
Extraordinary costs, net	0.0	0.0	0.0	0.0	0.0	0.4	7.0	40.2	4.9	*3%*	*-88%*	*-17%*
Capital Value (million €)												
Total value of assets	133.1	168.7	170.9	142.6	189.7	165.1	199.8	175.9	190.9	*108%*	*9%*	*13%*
Net Investments	6.7	18.5	8.7	3.6	2.3	3.9	20.4	3.8	7.2	*4%*	*88%*	*-15%*
Debt	48.9	65.3	105.6	101.6	125.6	85.3	86.0	76.1	84.4	*48%*	*11%*	*-3%*
Input & Production (thousand tonnes)												
Raw material: Feed	13.4	16.6	20.5	16.8	16.2	11.0	17.0	13.3	23.9		*79%*	*53%*
Raw material: Livestock	25.1	25.3	23.9	21.9	15.2	15.6	15.9	17.6	15.6		*-11%*	*-22%*
Performance Indicators(million €)												
Gross Value Added	27.7	33.2	46.2	53.3	60.6	31.2	49.2	61.4	71.0	*40%*	*16%*	*57%*
Operating cash flow	5.0	6.6	18.9	28.3	20.9	7.1	20.8	30.8	46.1	*26%*	*50%*	*166%*
Earning before interest and tax	1.0	2.1	5.6	22.7	12.8	0.1	15.8	21.7	40.3	*23%*	*86%*	*294%*
Net profit	-0.7	0.7	3.1	21.8	10.7	-2.9	9.4	12.7	35.4	*20%*	*179%*	*416%*
Capital productivity (%)	20.8	19.7	27.0	37.3	32.0	18.9	24.6	34.9	37.2		*7%*	*38%*
Return on Investment (%)	0.8	1.3	3.3	15.9	6.8	0.1	7.9	12.3	21.1		*71%*	*250%*
Future Expectation Indicator (%)	2.0	8.3	-2.7	-1.4	-3.0	-1.8	7.7	-3.0	0.8		*126%*	*2%*

Source: EU Member States DCF data submission

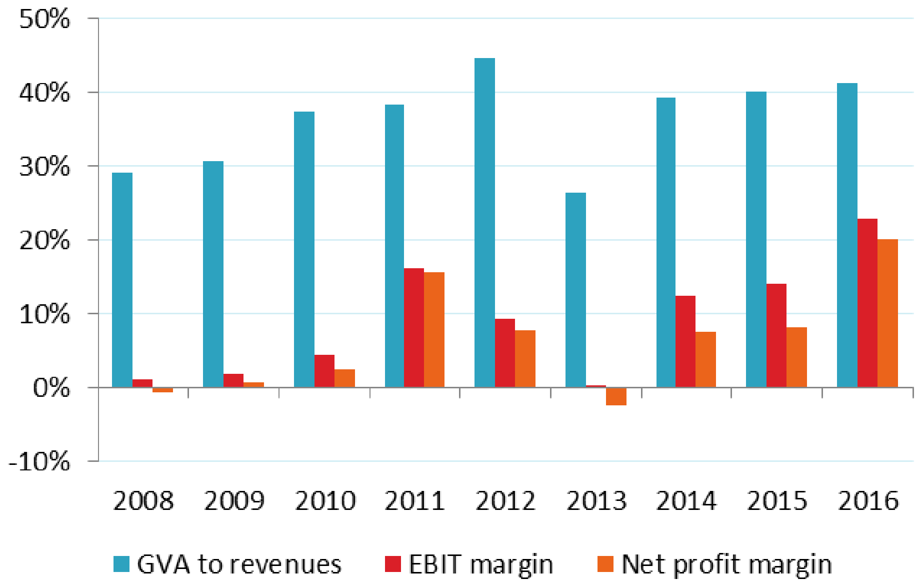


Figure 4.14.3 Economic performance for Ireland: 2008-2016
Source: EU Member States DCF data submission

4.14.4 Main species produced and economic performance by segment

Figure 4.14.4 shows the continuing dominance of the salmon, mussel and oyster segments in the overall production volume. However, in terms of both volume and value, salmon production dominates Irish aquaculture, particularly in sales value, due to a high unit value (Figure 4.14.5). Gigas oyster production volume, ignoring the oscillating pattern of rope mussel output, is now on a par with that of rope mussel. Oysters are the most valuable shellfish production segment by unit value as indicated in Figure 4.14.5 and there is still potential for farther increases in volume production and unit value. Bottom mussel production is harder to predict but probably will never reach the level of production of the early 2000s of 25 000 tonnes again. Rope mussel output generally oscillates between 8 500 and 10 500 tonnes with prolonged bay closures due to red tides limiting production volume and damaging continuity of supply. Mussel unit value for both segments has been comparatively low as this is effected by the home supply of mussels in France and Holland, traditional markets for Irish mussels. Certification such as mussel stewardship council and origin Green and Energetic marketing initiatives by more mussel companies seek to differentiate and add value to Irish mussels, while seeking new markets.

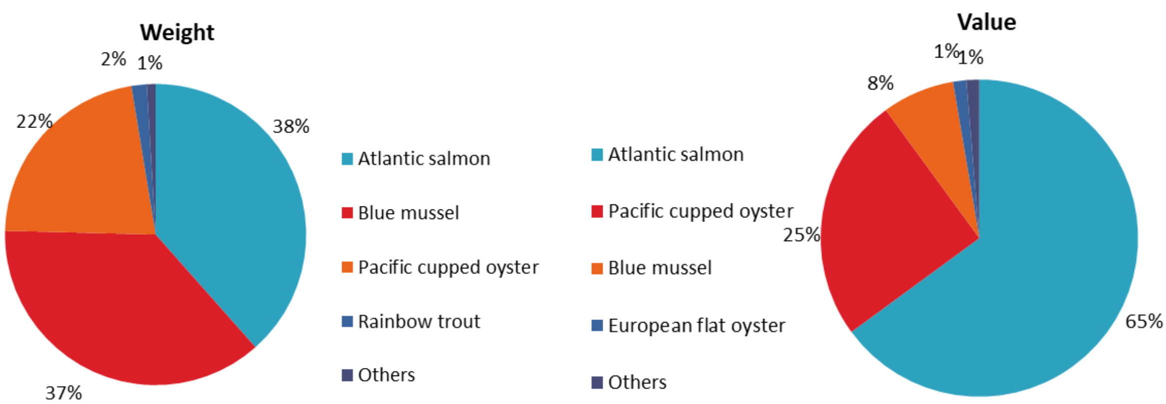


Figure 4.14.4 Main species in terms of weight and value in Irish production: 2016.
Source: EU Member States DCF data submission

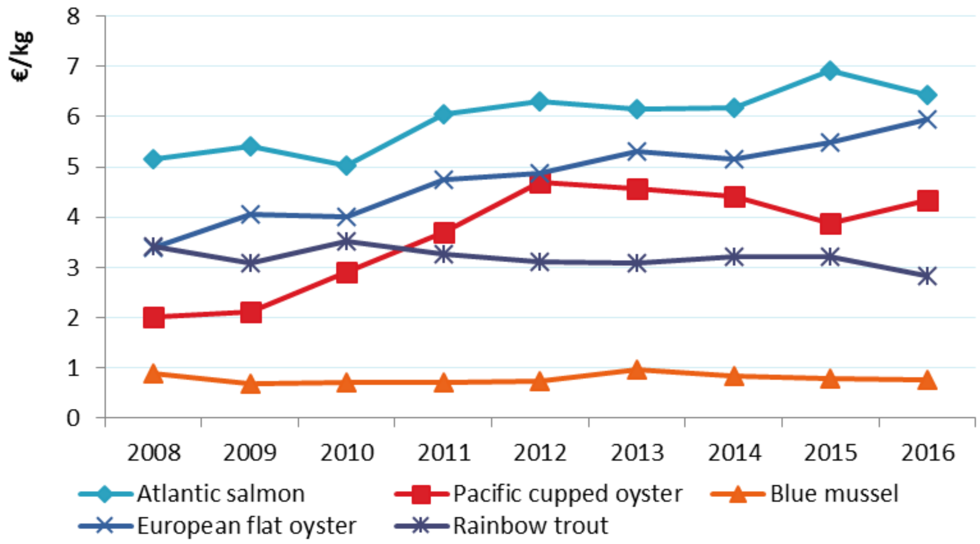


Figure 4.14.5 Average prices for the main species produced in Ireland: 2008-2016.
Source: EU Member States DCF data submission

Salmon unit value remains strong at above €6.40 per kg. Production is organically certified and supply is unable to match demand. This market status is expected to continue as indicated by 2016 and 2017 production volumes.

Gigas oyster average unit value dipped to just under €4 per kg in 2015, then recovered to €4.3 per kg. in 2016. The average belies the fact that an increasing number of businesses are getting increasingly better unit prices where these have come together to create a brand for niche markets such as the lucrative Asian market. Unit value for these branded oysters are generally from €5 to €6 per kg and sometimes more. Unit value for native flat oyster is generally greater than for Gigas, at €5 per kg plus.

Mussel unit values are relatively low, with bottom mussels, nearly all sold fresh bulk, getting the better price, in or around €1 per kg. Rope mussels sold fresh get in or around €0.75 per kg. Rope mussels sold for processing get less. Unit value has depended on the home supply or lack of, in the markets of France and Holland. Businesses in both mussel segments are branding as well as certifying their product to add value. Certification however quickly moves from distinguishing your product to becoming standard practice. Branding has a longer shelf life in this regard, before the product needs 're-inventing' once more.

Trout on-growing is a small and consolidating segment, with the dominant companies providing primary product for their own processing units. Unit value is holding steady at €3 per kg.

Segment 1.4: Salmon cages

Proportion of the industry: Salmon on-growing at sea is the largest segment of the Irish industry by volume and value; 38% and 65% respectively. FTE is 15.6% of national total in 2016.

Characteristics of the segment: A capital intensive segment with a modest proportion of national direct aquaculture employment, mainly full time, supporting other employment up an extensive economic value added and services chain. Ownership is by multinational and local business. 5 companies operate 12 to 13 production units over 34 sites. Presence is socially very important. Businesses tend to work individually and are self-contained.

Status: The economic indicators indicate profitability and growth in 2016 after a difficult 2013 to 14 period.

Main production tool: Sea cages and service vessels.

Production location: In exposed deep water bays along the entire west coast.

Input: Smolts ranging in size from 60 to 80 g., purchased or self-produced, are inputted in spring to a smolt site and then later to an on-growing site, within the production unit licenced area.

Production cycle: ranges from 9 to 18 months, producing various size classes, depending on market need, averaging at 3 to 5 kgs.

Output: The organically certified products are predominantly Whole-round or head on gutted, with fillets and other value added products also. Harvesting season tends towards all year production with fluctuating output intensity. Market is 20% home and the balance is exported primarily to Europe, also worldwide.

Factors limiting production: Regulation; Slow process (years) involved in obtaining and renewing licences, curtails capacity and access to grant aid. Parasites, such as lice need to be continuously controlled, ADG, jellyfish and algal blooms can have an effect from reduced feeding and conditioning to mortality. Environment, High energy fluctuating environments curtail production at either extreme of possible weather. High temperatures and low water movement or stormy conditions curtail feeding/ condition and can cause mortality, even without the effects of pathogens that these conditions may bring on.

Segment 8.4: Oysters other (bag and trestle)

Proportion of industry: Output of farmed (Gigas) oyster volume is on a par with rope mussels and generates by far the greatest shellfish sales value, at 25% of national total in 2016.

Characteristics: A labour intensive segment, with an even distribution of full time, half time and casual employment. Ownership is mixed with growing French investment and partnerships with local licence holders. The 145 businesses, active in 2016, range from companies employing over 30 people down to single self-employed sole traders. The majority are family owned, employing one full time and several part-time. Unpaid labour can be expected to occur within family run units. Businesses work mainly individually but seek state aid when there is access. Some also work collectively to create shared brands and better sales. The segment is socially important in remote areas.

Status: the segment is growing steadily in volume, unit value and employment since 2008 with increases in the value of all economic indicators such as GVA, net profit, etc., to 2016.

Main production tool: Bag on trestle, vessel or wheeled transport. Other systems such as SEPA hanging baskets and floating baskets are coming into greater use.

Production location: Intertidal; in shallow bays, within or near estuarine areas, widespread around the coast.

Input: Seed is purchased from hatcheries, primarily French ones, at a size from several grams upwards or half to near full size stock are purchased from other Irish based operations, depending on the production cycle stage focus of the business. Input of the smaller size classes occurs in spring or late autumn.

Production Cycle: The industry has moved towards spreading the production cycle over more than one site, optimising use of a site's particular growth capability. Thus there are producers who produce half grown stock, which are then sold to on-growers and then possibly on to fatteners before being sold to the consumer market. Time on site therefore can be anything from 2 months to 3 years, depending on the level of farm specialisation but generally is still from one to three years.

Output: As said above, is a half grown (< 65g) or consumer ready product of several size classes ranging from 65 g to 150 g plus. Product is sold fresh live. Harvesting is trending from autumn-winter to all year for the larger businesses.

Factors limiting production: Regulation; slow processing (years) of licence applications, new and renewals curtails production expansion and access to state investment. Mortalities; Gigas oysters are very susceptible to disease, possibly due to over breeding and mortalities can be frequent and large scale. Mortalities can be the end result of poor growth conditions, causing stress and vulnerability to disease. Absorption and accumulation of harmful organisms such as Noroviruses prevent sales.

Segment 7.3: Mussels bottom

Proportion of industry: Volume and value output was 14.7% and 3.5% of total respectively in 2016 and FTE was down to 7%. Employment is mainly full time.

Characteristics of the segment: The segment is capital intensive, providing mainly full time employment. Ownership is still mainly family owned but investment from Dutch companies has been increasing for some years. The social importance of the segment has diminished. 24 businesses remained active in 2016. Businesses work independently but have lobbied collectively over seed fishing access and resource management in general. State aid is sought when accessible.

Status: The segment is recovering from several years of seed supply difficulties and has stabilised in terms of number of businesses and output in 2016. The outlook for the segment is uncertain while it depends so heavily on wild seed availability for its raw material input.

Main Production Tools: Mussel dredgers.

Location: The east and southwest coast; concentrated within three Bays. Sites are shallow, sheltered and estuarine, subtidal with some intertidal juvenile shell hardening sites also.

Input: Seed of 20mm, 600 pieces plus per kg is fished in the summer and autumn, during weak tides and relayed on production sites by the company. A small number hire the dredger services of other companies to gather and relay for them.

Production cycle: one to two years depending on the site environment and the size class targeted for sale. Stock movement is within one production unit. Harvesting occurs from late autumn to mid spring of sizes from 80 to 90g, 80 to 110 pieces per kilo and can be for on growing or the consumer market, depending on the size, the market and the meat content. The market is predominantly Holland and France.

Factors limiting Production: Perceived top-down regulation and management; the industry has no control over access to wild seed beds and costs of complying with vessel C.O.C is very high compared to competitors. Supply of seed is almost entirely reliant on the settlement of wild beds, which do not occur every year in sufficient amounts. Weather conditions can lead to poor growth, meat content, stress and mortality or poor prices for poor meat yields.

Segment 7.2: Mussels long line

Proportion of industry: This segment continues as a relatively steady output volume performer, producing between 8 500 and 10 500 tonnes annually, depending on market strength or Bay red tide status governing harvesting permission. Output volume in 2016 was 9 770 or 22.2% of total output. Consistently low unit value explains the modest GVA of the sector. Output value in 2016 was 3.9% of total. The segment is a significant though weakening employer. FTE in 2016 was 13.2% of total. Employment is mainly part time or casual.

Characteristics: A labour intensive and socially very important presence in remote areas, offering seasonal employment alternatives to agriculture, tourism and fisheries. Businesses traditionally have been independent in nature, though there is some pooling of resources to minimise the effects of bay closures and improve harvesting continuity of supply and unit value. State aid is applied for if available. The sector is almost entirely locally owned with a degree of unpaid labour among the family run enterprises. The segment is becoming gradually more capital intensive as overall employment numbers and numbers of individual businesses declines. As the age profile of licence holders advances, more and more sites are being leased or transferred to better equipped and more committed entities.

Status: The sector has struggled to remain profitable as economically indicated, despite successful investment in technical innovation and efficiencies, as well as in product certification. Output volume can be expected to remain within the current output fluctuation pattern, though with less direct employment, less businesses (59 in 2016) and gradually improving output values, if value added projects succeed.

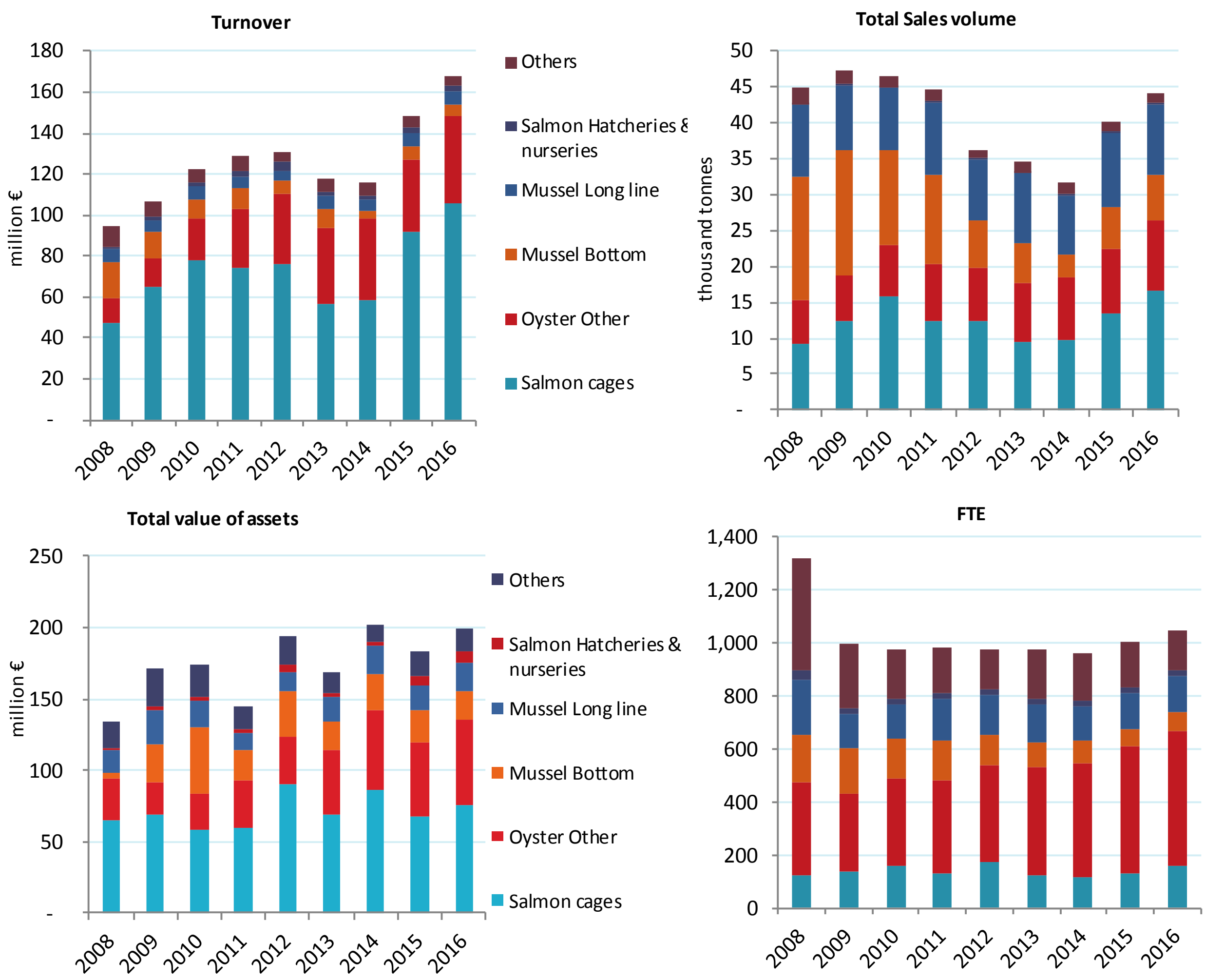


Figure 4.14.6 Structural development Irish aquaculture sector: 2008-2016.
Source: EU Member States DCF data submission

Main production Tool: Suspended ropes, service vessels.

Location: The segment is found mainly in the deep bays of southwest and present in other suitable west coast bays. Sites vary from sheltered to moderately exposed.

Input: Seed is collected from suspended collectors close to the production lines in spring. Costs are usually minimal compared to other segments.

Production Cycle: 1 to three years depending on location, growth conditions and market need. Stock movement is within one site.

Output: Harvesting occurs mainly from late autumn to early spring, or whenever harvesting is permitted in the bay while a market is open. The product is sold fresh and consumer ready to France, Holland, Italy and elsewhere in Europe at sizes of 80 to 90 g, 80 to 100 pieces per kg and is also sold to local processors and a few companies sell half-growns to bottom mussel producers.

Factors limiting production: Bay closures can be lengthy and can occur at the height of harvest season, disrupting supply, reducing sales value and increasing losses of stock from the lines. Adverse weather can lead to poor growth and yields. Regulation; application processes for new or renewed licences is slow (years), curtailing expansion of capacity and preventing access to state aid. Low market unit value relative to competitors continues. Efforts continue to increase the profile and value of Irish mussels abroad and to develop the home market close to production sites.

The above bar graphs of Figure 4.14.6 show the changing proportions of national output of each segment between 2008 and 2016. Salmon production output has dominated and Gigas oysters (Oysters other) grew to become the most value generating shellfish segment and largest direct employer in Irish aquaculture. Although salmon is capital intensive in comparison, there is a considerable economic chain stemming from site production to the tune of 2.5 to one production FTE. Rope mussels is another important direct employer, labour intensive segment that, along with oysters is socially very important, providing employment, albeit seasonal, to areas with marginal agriculture, seasonal tourism and seasonal inshore fishing as alternatives.

Table 4.14.4 Economic performance of main Irish aquaculture segments: 2008-2016 (in million €).

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	*% of total income*	Change 2016/15	Development 2016/(2008-15)
Salmon cages												
Total income	*47.6*	*65.5*	*77.7*	*76.6*	*77.2*	*57.1*	*59.6*	*93.5*	*106.6*	*100%*	*14%*	*54%*
Gross Value Added	*12.7*	*17.0*	*23.6*	*24.5*	*23.1*	*-2.1*	*15.9*	*32.2*	*30.7*	*29%*	*-5%*	*67%*
Operating cash flow	*5.5*	*3.7*	*10.3*	*20.3*	*1.7*	*-7.0*	*10.8*	*21.7*	*25.4*	*24%*	*17%*	*204%*
Earning before interest and tax			*9.5*	*19.5*	*-0.2*	*-8.9*	*9.8*	*17.5*	*24.8*	*23%*	*42%*	*215%*
Net profit			*9.4*	*19.4*	*-0.2*	*-9.6*	*8.9*	*15.5*	*24.3*	*23%*	*56%*	*236%*
Total sales volume (thousand tonnes)	*9.2*	*12.3*	*15.9*	*12.5*	*12.4*	*9.4*	*9.7*	*13.5*	*16.7*		*24%*	*41%*
Oyster Other												
Total income	*12.7*	*14.0*	*20.9*	*30.0*	*36.2*	*37.7*	*47.9*	*39.1*	*45.6*	*100%*	*17%*	*53%*
Gross Value Added	*3.8*	*5.2*	*10.9*	*16.4*	*26.9*	*22.1*	*26.7*	*24.6*	*30.5*	*67%*	*24%*	*79%*
Operating cash flow	*-5.3*	*0.1*	*5.7*	*9.8*	*18.9*	*8.8*	*10.2*	*13.8*	*18.5*	*41%*	*34%*	*138%*
Earning before interest and tax	*-6.7*	*-1.3*	*4.2*	*8.2*	*17.2*	*7.2*	*9.4*	*12.4*	*15.8*	*35%*	*27%*	*150%*
Net profit	*-6.8*	*-1.4*	*4.1*	*7.8*	*16.6*	*6.0*	*6.2*	*7.9*	*14.9*	*33%*	*88%*	*196%*
Total sales volume (thousand tonnes)	*6.2*	*6.5*	*7.1*	*7.7*	*7.4*	*8.2*	*8.9*	*9.1*	*9.7*		*7%*	*27%*
Oyster Bottom												
Total income	*1.3*	*1.5*	*0.9*	*1.4*	*1.2*	*2.5*	*2.9*	*2.6*	*2.4*	*100%*	*-9%*	*32%*
Gross Value Added	*1.2*	*1.4*	*0.8*	*1.2*	*1.0*	*2.2*	*2.6*	*2.5*	*2.1*	*90%*	*-13%*	*32%*
Operating cash flow	*0.6*	*0.7*	*0.7*	*-1.1*	*-0.5*	*1.0*	*1.2*	*1.5*	*0.7*	*31%*	*-50%*	*45%*
Earning before interest and tax	*0.5*	*0.7*	*0.7*	*-1.1*	*-0.5*	*1.0*	*1.2*	*1.4*	*0.6*	*24%*	*-59%*	*15%*
Net profit	*0.5*	*0.7*	*0.7*	*-1.1*	*-0.5*	*1.0*	*1.2*	*1.4*	*0.6*	*24%*	*-59%*	*16%*
Total sales volume (thousand tonnes)	*0.4*	*0.4*	*0.2*	*0.3*	*0.2*	*0.5*	*0.6*	*0.5*	*0.4*		*-20%*	*2%*
Mussel Long line												
Total income	*7.3*	*5.7*	*6.6*	*11.1*	*5.0*	*5.8*	*5.9*	*6.8*	*6.9*	*100%*	*2%*	*2%*
Gross Value Added	*3.4*	*3.9*	*4.7*	*2.9*	*1.6*	*2.6*	*1.5*	*3.0*	*5.1*	*74%*	*69%*	*73%*
Operating cash flow	*1.4*	*1.8*	*1.7*	*-3.3*	*-0.8*	*0.8*	*-0.5*	*0.0*	*1.7*	*24%*	*3937%*	*1087%*
Earning before interest and tax	*1.2*	*1.4*	*0.9*	*-4.5*	*-1.8*	*-0.2*	*-1.8*	*-0.8*	*1.0*	*14%*	*222%*	*241%*
Net profit	*1.2*	*1.3*	*0.4*	*-4.6*	*-2.1*	*-1.0*	*-3.0*	*-1.2*	*-0.2*	*-3%*	*84%*	*83%*
Total sales volume (thousand tonnes)	*10.1*	*9.0*	*8.8*	*10.1*	*8.6*	*9.8*	*8.2*	*10.3*	*9.8*		*-5%*	*4%*
Mussel Bottom												
Total income	*17.3*	*13.3*	*9.2*	*10.8*	*8.6*	*9.2*	*4.2*	*6.5*	*7.9*	*334%*	*22%*	*-20%*
Gross Value Added	*2.5*	*2.8*	*5.0*	*4.1*	*5.9*	*5.4*	*1.0*	*-2.1*	*1.0*	*42%*	*146%*	*-68%*
Operating cash flow	*0.0*	*0.4*	*1.4*	*1.2*	*2.6*	*3.8*	*-1.0*	*-5.6*	*0.3*	*14%*	*106%*	*-6%*
Earning before interest and tax	*-1.6*	*-1.3*	*-7.8*	*0.5*	*0.7*	*2.1*	*-2.4*	*-7.8*	*-0.8*	*-35%*	*89%*	*63%*
Net profit	*-2.7*	*-1.9*	*-9.4*	*0.4*	*-0.4*	*2.0*	*-3.0*	*-9.8*	*-2.6*	*-110%*	*73%*	*16%*
Total sales volume (thousand tonnes)	*17.0*	*17.5*	*13.2*	*12.5*	*6.5*	*5.5*	*3.2*	*5.7*	*6.5*		*14%*	*-36%*

Source: EU Member States DCF data submission

The economic indicators of table 4.14.4 and graphs below, apart from GVA, show recovery of salmon to relative economic health by 2016. Salmon undergoes cyclical economic fortune. The sector is the biggest economical contributor, even in bad production years.

The table above and graphs below highlights the struggle of the two mussel segments to remain profitable in the face of low value output to production effort and the factors that cannot be controlled; seed mussel supply for bottom and harvest holdups for rope mussels. The negative values for profitability reflect the closure of some bottom and rope entities and their amalgamation into economically fitter enterprises.

The steady growth in volume and value of oysters is reflected by positive indicator values. Economic contribution has increased with GVA and employment increasing year on year over the period.

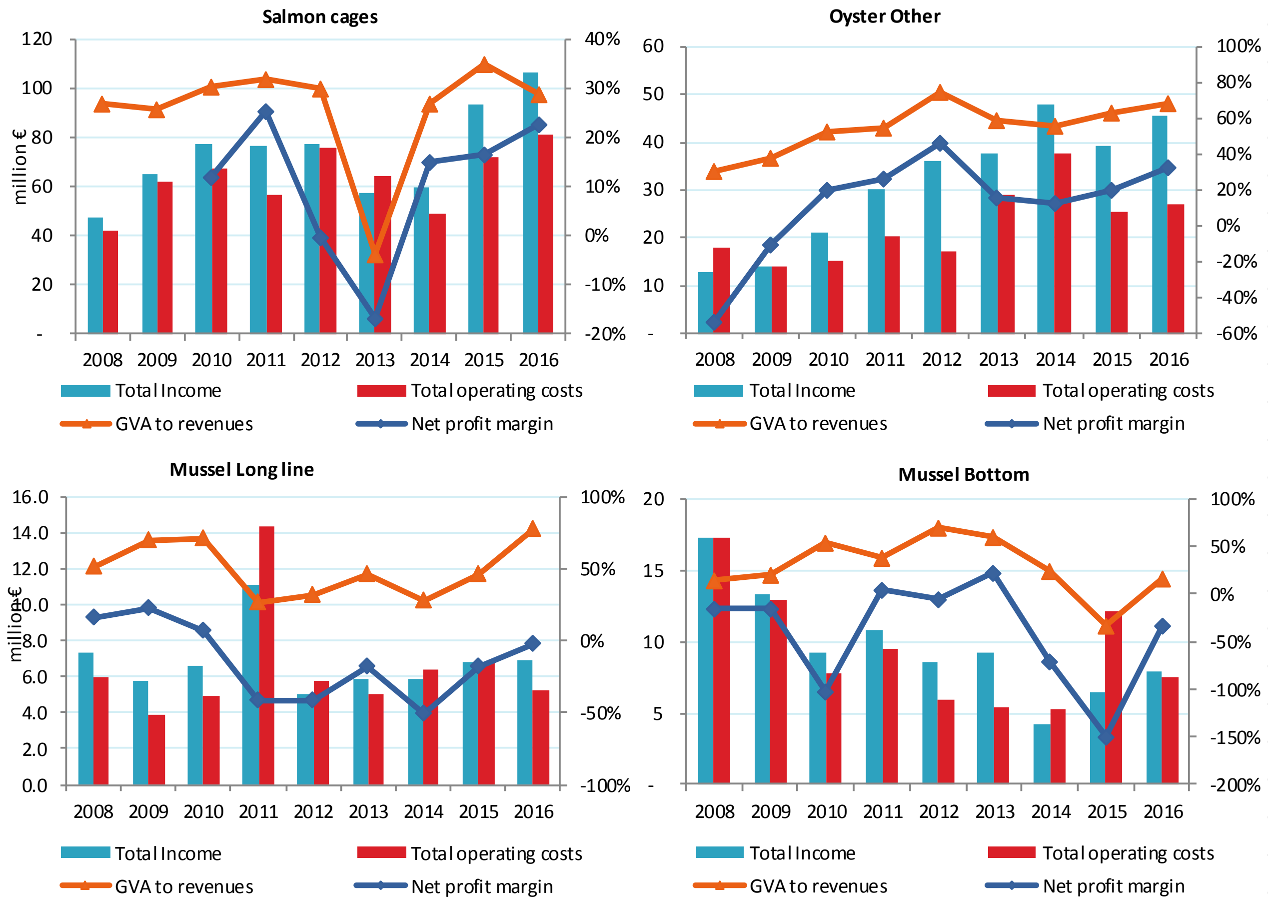


Figure 4.14.7 Economic performance indicators for the main Irish segments: 2008-2016.
Source: EU Member States DCF data submission

The graphs above show the high cost to turnover ratios for all segments, showing the challenge to maintain profitability and economic contribution. This is particularly the case for the low unit value mussel sectors.

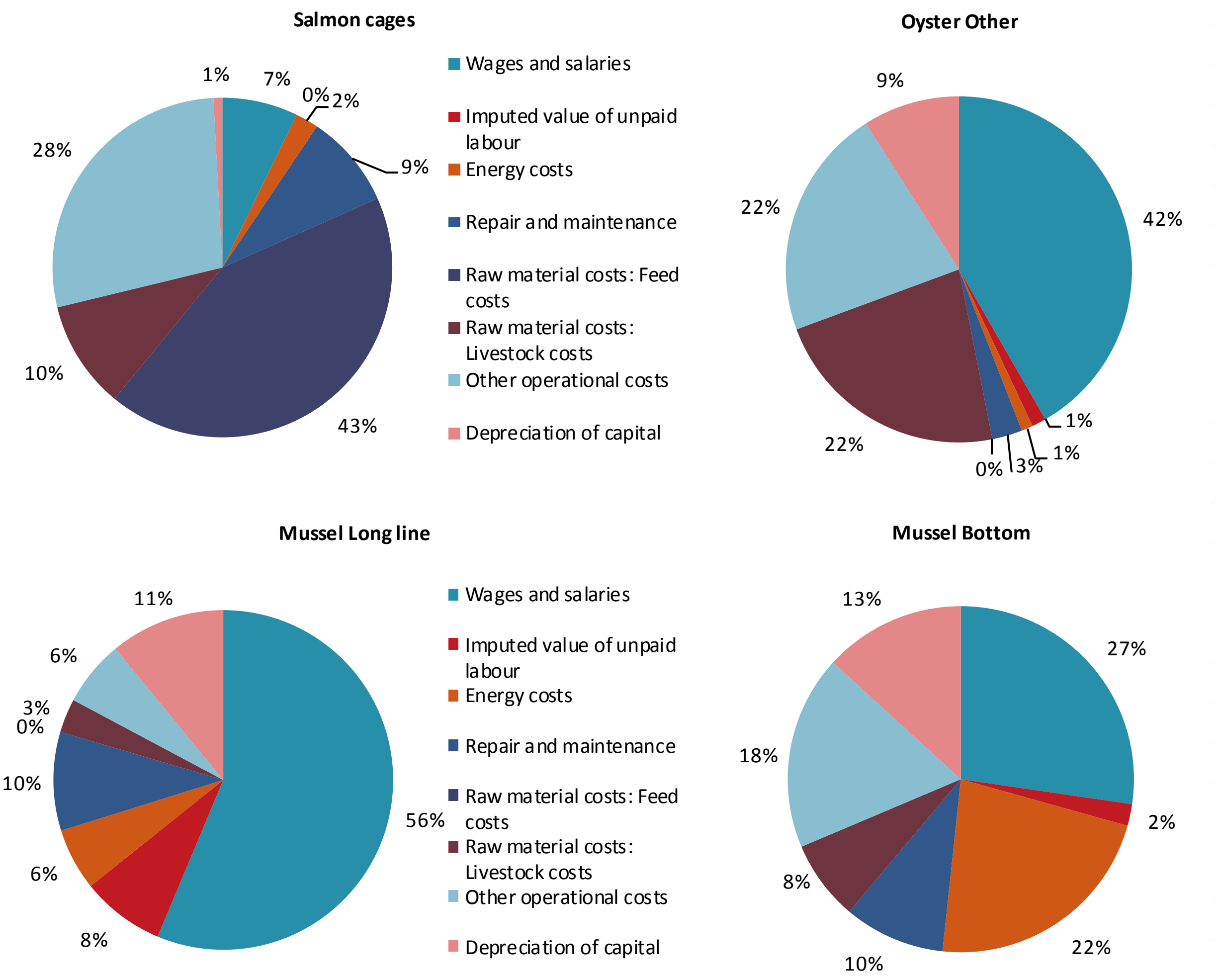


Figure 4.14.8 Cost structure of the main segments in Ireland: 2016.
Source: EU Member States DCF data submission

Figure above illustrates the relative proportions of national production costs for each of the 4 main segments.

The biggest cost for salmon and the profit margin decider in normal years is feed. Other operational costs are also a significant cost. As a capital intensive sector, direct employment costs are relatively small compared to the labour intensive rope and oyster segments.

Labour, raw material input and other operational costs are the biggest costs in the off-bottom oyster segment. Labour is the biggest cost for the rope mussel segment. There is a broad spread of significant costs for the bottom mussel segment, with raw material input cost showing the most unpredictable variation while other costs are typical of those attendant on fishing vessels Raw material supply costs are the crucial profit-loss decider. Depreciation of capital is also significant in this sector, owing to the necessary ownership of large specialised vessels for seed gathering.

Wages and salaries are decreasing as a cost for the rope sector as it gradually becomes more capital intensive. Raw material costs are slight for this segment, as supply is usually close by, reliable, subject to good year-bad year settlement fluctuations and is self-collected by the businesses.

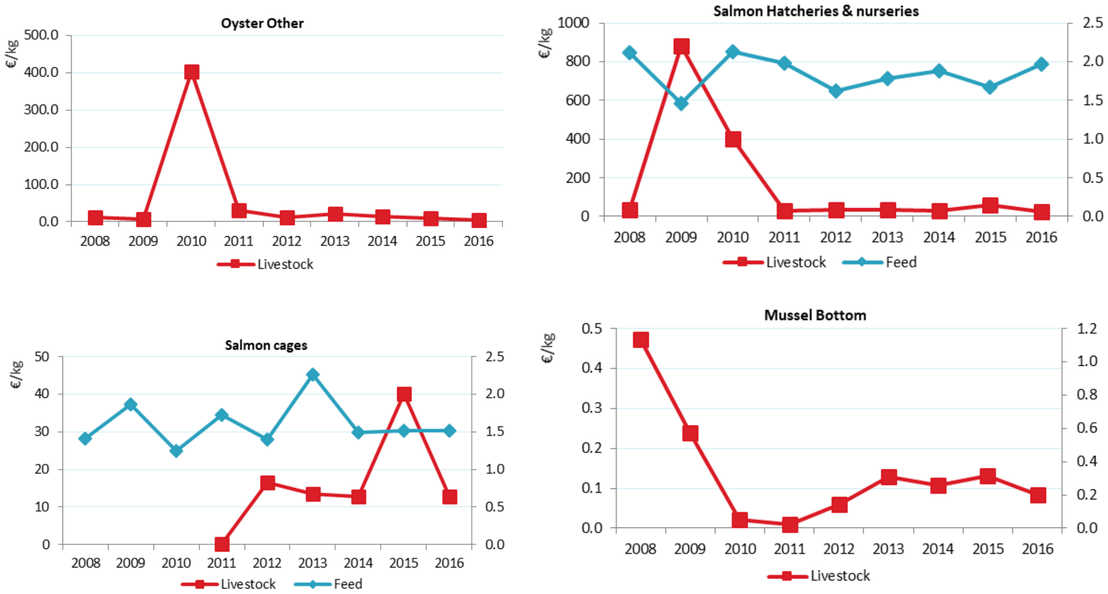


Figure 4.14.9 Feed and livestock prices for the main Irish segments: 2008-2016.
Source: EU Member States DCF data submission

4.14.5 Trends and triggers

Current production trends and main drivers

Production trends generally are expected to increase volume output and unit value though salmon output may experience a decrease in 2018 due to smolt supply issues.

Salmon and bottom mussels had recovered from output lows; caused by the effects of ADG in the case of salmon and seed supply in the case of bottom mussels. A moderate quantities of seed have been found in the Irish Sea from 2014 to 2017 that raised production in 2015, 2016 and 2017 to 5 697, 6 475 and 7 791 tonnes, respectively.

Gigas oyster output continues to increase, as with its average unit value; €4.38 per kg in 2017. The rope mussel sector increased output in 2015 to 10 318 tonnes, with an average unit value of €0.65 but dropped back to 8 559 tonnes at 0.67 euros per kg in 2017. The main concern for the rope sector is the increasing frequency of red tides and the resultant closures of bays to harvesting which can continue for months, during which time, large quantities of stock are lost from the lines and markets are lost.

Market structure

Irish aquaculture is still primarily a supplier of bulk live shellfish and round or head-on gutted finfish to a mainly export market on the European mainland and beyond. Distance from market is an ongoing challenge for rapid delivery of a highly perishable product. The traditional purchasing countries of Irish oysters and mussels have large home production of the same shellfish species and large home markets. The Irish supply had the role of supplement supply to these. The main importers of aquaculture Shellfish produce, in order of quantity in 2016 were; France, Spain, Netherlands, Italy, Germany and the UK, with the far East gaining in importance. Principle importers of finfish (salmon) in 2016 were France, Germany, UK, Belgium, Switzerland, North America and others.

As previously stated, efforts are being made to diversify markets, differentiate product and add value. All salmon is organically certified while oysters and mussels are being certified in a drive to differentiate Irish shellfish from the rest. A new departure in Ireland is to link stakeholders in the coastal resource for mutual and increasing benefit. The 'Wild Atlantic Way is a brand and a package where holiday makers can follow coastal routes, along which they can visit fish farms and sample their products at source. 'Taste the Atlantic' is a derivative product of the brand where tourists can do a shellfish sampling tour of the west coast. For fish farms, especially the smaller family run ones, this is an alternative income stream and the chance to paint a positive picture of aquaculture in an enjoyable way for both producer and visitor. The number of subscribing farms and the number of routes are increasing since the ideas inception in 2013 and is a good example of how businesses and state bodies, in this case food, marketing, innovation, tourism and aquaculture agencies can pool resources for the collective good. This tourist package also supplements the branding of Irish seafood products as a highly healthy nutritious product, coming from the exposed, wild and clean Atlantic environment. In this way, the challenge posed by distance from the European centre is being used to advantage as a marketing tool.

Ireland The EMFF, Expectations

The capacity for sustainable increasing aquaculture output will continue to be curtailed by capacity; shortage of new sites and insecure seed supply in the case of bottom mussel. Projections for The EMFF period per major segment nevertheless seem to rely on the year of highest historical production for the base year, rather than on a suitable period average.

Rope mussels are projected to reach 14 065 tonnes. Having occurred once before, this represents maximum possible output with current capacity and will require major co-ordination of the rope mussel producers and state agencies to counteract the restrictions to output such as red tide induced Bay closures to harvest. Open Bays would have to be relied upon to cover for closed bays. The alternative is a significant increase in capacity, which is unlikely. Unit value, with intense marketing and top certification can be expected to increase.

Bottom mussels are projected to reach 29 976 tonnes. Again this figure was the high water mark of previous production in the early 2000s. A project to provide a significant alternative to the supply of wild seed is underway and any goal of sustainable output increase for this sector is dependent on the success of this or similar projects run in other MSs. Unit value, as with Rope mussels, can be expected to improve, with continuing strenuous product differentiation efforts.

The bag and trestle Gigas segment alone has reached over 9 800 tonnes production in 2017, exceeding the projection of 9 270 by end of EMFF period. Increased efficiency of licenced ground use, the steadily increasing overall licenced area efficient management of mortality events, will allow output volume of this segment to significantly farther exceed the EMFF projection.

Combined Finfish segments are set to reach 25 082 tonnes, principally via the salmon segment. A medium sized new production unit had recently been licenced to begin operations. Similar sized units are undergoing the application process but optimism for the increase in salmon production output is frustrated by the continued ability of hostile lobbies to delay the start of production. The completion of the new licence process should eliminate these damaging cul de sac routes to expansion. The maintenance or increase in unit value is achievable as the premium reputation of Irish salmon products is farther marketed. Potential increases in freshwater finfish production, subject to the success of a project to use old peatland sites along the catchment of the country’s longest river for production, are also very possible. The above finfish tonnage projection for the EMFF period is a realistic target.

Issues of special interest

Partnerships with other stakeholders have been mentioned to broaden aquacultures potential and allow it to tell its story. Unlike in other member states, aquaculture has hitherto fore occupied a marginal place in the public consciousness and there was no significant home market for shellfish products. The image of fish-farming had been largely fashioned by those opposed to the industry, especially the lobby opposed to salmon farming.

The application by the state agency responsible for aquaculture development, BIM to obtain a licence for a 15 000 tonne offshore salmon production unit in the west has been withdrawn as new legislation has put a 6 000 tonne limit on salmon unit sizes, thereby disqualifying the application. The unit, would have doubled Irish production when at full capacity, had it been given permission to go ahead. A smaller unit has recently been licenced in the southwest and farther sites are under the application process.

State investment in the industry is following 4 pillars: training, innovation competitiveness and sustainability. Under these headings a number of familiar challenges to the industry are being tackled.

Bottom mussels: A project to provide an alternative seed supply to the industry is underway, following an earlier project more intensively, this seeks to gather seed as done for the rope industry on vertical collector surfaces that can then be transferred to the seabed.

Oysters and other shellfish: Shellfish Hatcheries and stock are being funded to develop and provide a local, disease free seed supply (including triploid stock for gigas) alternative to the shellfish sectors that rely on imported seed or, in the case of scallops, on an infrequent and highly localised natural spatfall. Another initiative is investigating how to pool resources of state agency and business to enable maximum access to approved depuration facilities.

Salmon: A project, is underway to treat lice and other parasites with fresh water, using an on-site de-salination unit and a bulk freshwater transport tarpaulin that can be quickly and cost effectively deployed. Also the use of such fish cleaner species as wrasse and lumpsuckers continues to be developed.

Outlook for 2017 and 2018

The outlook is for continued recovery in the form of steady increases in salmon and oyster volumes, with unit value also increasing in shellfish in general, as the marketing and branding efforts pay off. Salmon unit value should hold at least over this period as demand continues to rise worldwide. Mussel unit value should increase for the same marketing effort reason though output fluctuations are governed by the un-controllable factors of seed supply for bottom mussels currently and the occurrence of red tides for rope mussels. Indeed, the output for oysters cannot be guaranteed either as sales are curtailed by both viral and bacterial induced mortalities and the increase in the presence of norovirus in bays which could accumulate in shellfish, leading to harvest and sales stoppages.

The 2015 figures show these expected outlooks as all four major segments reported a strong increase in volume output and moderate unit value increases.

4.14.6 Data Coverage and Data Quality

Data quality

The quality of census data; production and employment variables are generally of good quality. The census survey is a long established in-house survey used to inform BIM development programs and is widely used by other agencies. The producers themselves participate in the order of 80% of the population. These participate at least to some extent because the results are published within a month or so of survey compilation and the results are of interest to them.

Certain financial variables, available on-line are of good quality but as most businesses are small, the accounts available online are abridged, providing data for depreciation, assets, debts and often not much more. As these are got online, the response rate is 100%. The target sample is 33%. Access to full accounts is difficult owing to the clients suspicion of survey motives and their own limited access to accountants.

Up to now the most difficult data to obtain and the least reliable, have been the operational costs variables that tend to be located in full financial accounts. These variables are gathered by direct sample survey and are: wages and salaries, energy costs, repair and maintenance and other operational costs. Often the surveyed are unsure of their own data in the case of these variables. Also the variables net investments and financial costs have proved difficult to obtain. 20% of the population is the target sample but returns can be well under 10%, depending on the segment and the variable.

Data availability

Census data first becomes available for dissemination by April of the year n+1, with provisional figures available a month earlier. Operational costs and financial data are gathered by February of year n+2, with provisional dissemination possible by the end of March, year n+2.

Confidentiality

A policy document on confidentiality, in line with the protection of information act and the requirements of GPDR, is being produced by BIM, the agency charged with gathering and presenting aquaculture data for DCF, Eurostat, FAO and other institutions. As a rule, when the population of a segment of whichever dataset drops to three business entities, that segment is reviewed to decide if it can continue to be reported as an independent segment, without exposing the data of an individual. If the segment population should drop farther, the segment is amalgamated into the next most compatible segment if possible. The above rule applies to all but the very largest companies who dominate their segments and without the participation of whom, the survey would be seriously compromised.

Differences in DCF data compared with other official data sources

DCF and Eurostat/FAO estimates are compared in figure 4.14.10. The updated figure for 2015-2016 was not used due to a technical error. There is broad agreement between the estimates with a difference in how juvenile salmon are segmented between the two groupings. Differences may occur between the estimates made for DCF, Eurostat, FAO on the one hand and those made by Producer organisations, in particular the representatives of shellfish producers, who may have better access to their clients. There are frequent cross references and cooperation between POs and EU data collectors. The estimates of the latter may err on the conservative side for shellfish and has over estimated for salmon production on at least one occasion.

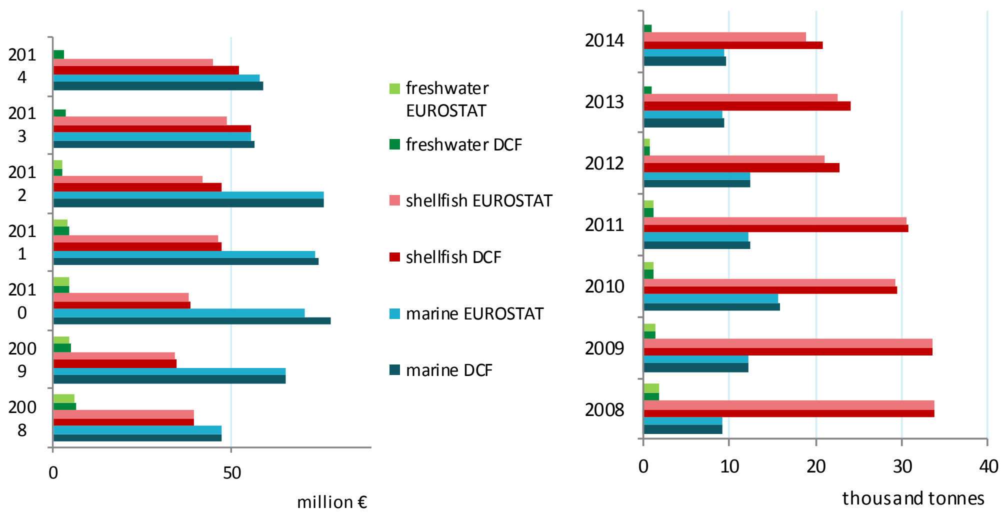


Figure 4.14.10 Comparison of DCF data with EUROSTAT data for Ireland: 2008-2016

The census survey held annually creates a common pool of raw data used for supplying both Eurostat and DCF requirements. The main differences in estimations are the time lag between the two data requests and the manner in which the data had been segmented differently for the two different regulations. Also DCF does not differentiate between volume output for consumption or farther ongrowing. The question being asked varies between the institutions, hence like is not quite being compared with like. There is close agreement between the Eurostat and FAO datasets as they are both similarly organized and only several months lie between their upload times.

One area of variation requires clarification; the different ways that smolt production is organized between Eurostat and DCF. At first they were organized in the same manner, then due to a query made by DCF end user, the segmentation in the case of the DCF was changed. In the Eurostat dataset, the total smolt production volume is given. In the DCF dataset, only the data of standalone salmon smolt producing companies populate the segment 1.1; Salmon hatcheries. A DCF end user can obtain an average unit value for smolts using the variables turnover divided by sales volume of segment 1.1. Previously smolt production units that were part of companies whose main business is selling ongrown salmon had been included in DCF segment 1.1. In the Eurostat dataset, they still are and the volume of smolts produced in the auxiliary units does generate some turnover, depending on what proportion of such smolts are sold and what proportion is used to supply in house ongrowing sites. As these smolt units are economically tied to the ongrown segment (seg 1.4 cages) any turnover generated is added to the ongrown turnover. Overall national turnover for both datasets is basically the same, barr time lag adjustments.

4.15 Italy

4.15.1 Production and sales

In 2015, total Italian aquaculture production amounted to 190 thousand tonnes in volume, and around €490 million in value. Both volume and value are fluctuating over the period 2009-2015, but, considering the last reporting period, the sector shows an increase: 2% in volume and a decrease in value, -12%. The growth achieved in 2015 by the shell segment, equal to + 16% in volume and over 31% in sales turnover, was neutralized by the negative performance of the freshwater segment and the marine species segment. In particular, the freshwater segment, mainly characterized by the trout and salmon trout, has undergone an unpredictable and not previously verified contraction. Expectations foresee a recovery of the trout segment, of around 1.3%, starting from 2017. During 2015 and 2016, the reduction in the offer of freshwater fish directed consumers to buy imported products and to consume fish fillets. The sector's potential to grow and be better able to meet the growing demand of Italian farming fish market. Consumers are favourably predisposed to direct household purchases of farmed fish, especially if the aquaculture products can guarantee the quality and, especially, if they are made in Italy. In 2015, the marine segment was hit by a loss of product, because it was immediately dampened. The reduction (-30% compared to 2014) also affected the fall in turnover (-20%).

Table 4.15.1 Production and sales for Italy: 2008-2015.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	Change 2015/14	Developm. 2015/ (08-14)
Sales weight (thousand tonnes)	***222.6***	***217.2***	***270.8***	***157.0***	***191.2***	***153.9***	***185.8***	***189.9***	*2%*	*-5%*
Marine	12.6	14.1	16.2	12.1	11.7	16.5	24.0	16.8	*-30%*	*9%*
Shellfish	97.9	89.4	173.7	83.7	109.5	83.3	105.7	122.2	*16%*	*15%*
Freshwater	112.1	113.7	80.9	61.3	70.0	54.0	56.1	51.0	*-9%*	*-35%*
Hatcheries & nurseries	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Sales value (million €)	***439.5***	***608.4***	***585.3***	***422.9***	***464.9***	***481.3***	***566.9***	***498.1***	*-12%*	*-2%*
Marine	113.2	125.8	138.5	70.6	79.9	114.6	181.0	144.2	*-20%*	*23%*
Shellfish	68.7	149.7	182.9	146.3	135.3	122.9	146.7	191.9	*31%*	*41%*
Freshwater	257.6	332.9	264.0	206.0	249.6	243.7	239.2	162.0	*-32%*	*-37%*
Hatcheries & nurseries	0.0	0.0	0.0	0.0	0.0	0.0	0.0			

Source: EU Member States DCF data submission

Italy is capable of producing the necessary quantities and abundant production that used to export the fry/juveniles in other countries. During 2015-2016 the national aquaculture farms association had reported around 500 million of juveniles of seabass and seabream sold in EU. During the previous period of analysis (until 2015) there was recorded a trend to export fry to Extra Eu countries. The trend in recent years had stopped, caused for difficulty to finalize the payment. For the freshwater sector, the situation is different: Italy satisfies only in part the demand of fry, so it imports large quantities from other European countries; but in recent last three years, Italian producers signed agreement with some extra European countries (e.g. Peru, Iran) for the sale of embryonated eggs. In the field of aqueducts, examples of differentiation of production are reported, mainly oriented towards exports, especially in Germany, Austria and recently also in some Arab countries. The tendency to satisfy new international consumers is demonstrated by the presence in the trout sector of companies that have the Halal certification, the Islamic certification for slaughter.

4.15.2 Industry structure and employment

In 2015, Italy has 711 companies, a value that has increased by about 20% since the previous three-year period. Companies with more than 10 employees have suffered a reduction of -7% compared to 2014, and -18% compared to the entire previous period 2008-14. Compared to employee classes, the structure of companies confirms the presence of a fabric strongly characterized by companies with less than 5 employees (over 440 companies with <= 5 employed). Total employees in 2015 were 4 917, only 4% less than the previous year, and tend to be a decrease of -6% compared to the period 2008-2014. The female presence is strongly reduced, especially compared to the period 2008-2014, with a reduction of over 43%. The main cause of reduction of female presence is due to the reduction of land-based aquaculture farms (both marine and soft): in cages the work is heavier and not suitable for women who must also carry out care and family. The value of the FTE increased (+16%) over the period 2008-2015, due to the use of more specialized personnel, which for long periods is permanently occupied in aquaculture. The training aspect is reported both by the farmers' association and by the directors of the companies. Much must be invested in new skills specifically trained for aquaculture. To improve the preparation of employees in the sector, the Associations of Fishers and Minters have started various ongoing training activities. the funds used are those of the EMFF, and European programs, such as ERASMUS Plus.

Table 4.15.2 Structure of the Italian aquaculture sector: 2008-2015.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	Change 2015/14	Developm. 2015/ (08-14)
Structure (number)										
Total enterprises	*696*	*696*	*692*	*589*	*587*	*587*	*587*	*711*	*21%*	*12%*
<=5 employees	366	366	366	315	325	325	325	444	*37%*	*30%*
6-10 employees	175	175	166	139	140	140	140	153	*9%*	*0%*
>10 employees	155	155	160	135	122	122	122	114	*-7%*	*-18%*
Employment (number)										
Total employees	*4,357*	*5,884*	*5,836*	*5,076*	*5,159*	*5,064*	*5,112*	*4,917*	*-4%*	*-6%*
Male employees	4,053	5,459	5,299	4,032	4,324	4,405	4,342	3,988	*-8%*	*-13%*
Female employees	304	425	537	1,044	835	659	770	929	*21%*	*42%*
FTE	3,428	3,612	2,839	2,117	1,938	2,212	1,695	2,962	*75%*	*16%*
Male FTE	3,155	3,324	2,676	1,914	1,777	1,985	1,528	2,506	*64%*	*7%*
Female FTE	273	288	163	203	161	227	167	456	*173%*	*115%*
Indicators										
FTE per enterprise	4.9	5.2	4.1	3.6	3.3	3.8	2.9	4.2	*44%*	*5%*
Average wage (thousand €)	34.9	29.6	38.8	30.9	37.0	48.1	81.5	37.3	*-54%*	*-13%*
Labour productivity (thousand €)	31.3	57.8	83.1	73.6	106.2	97.5	136.1	86.3	*-37%*	*3%*

Source: EU Member States DCF data submission

The profile of the employee has been gradually modified, making greater use of skilled labour and increasingly longer contracts in terms of duration. In 2015, due to a reduction in sales volumes and sales, there was a negative trend for labour productivity per company, equal to €86.3 thousand, down by -37% compared to the 2014, while slightly higher (+ 3%) compared to 2008-2014. The average wage, then the remuneration of the employed is equal, in 2015, to approximately 37 thousand euros, a value 54% lower than the year before. The reduction in average wages can be justified by the presence of fewer part-time employees. This reduces the fixed quota of wages linked to social security and health insurance and accident insurance costs. Surely the Italian aquaculture can achieve higher levels of productivity.

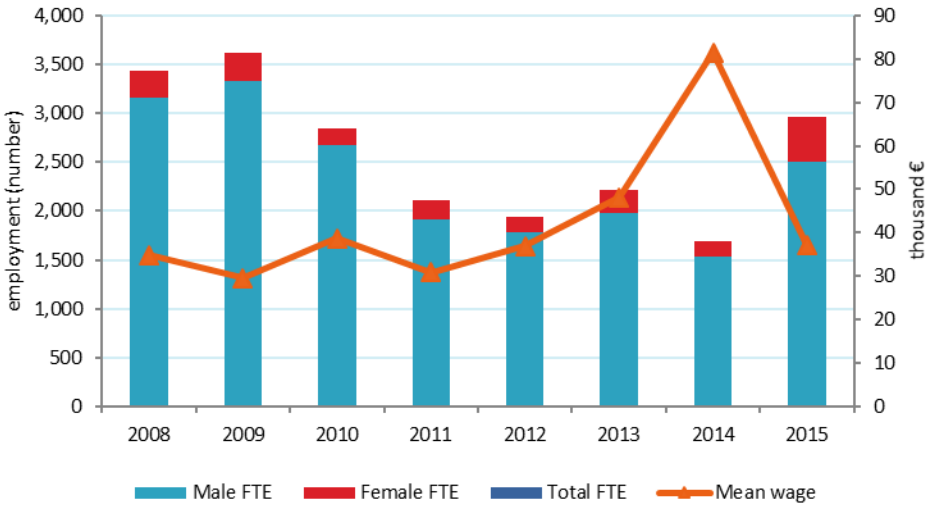


Figure 4.15.1 Employment trends for Italy: 2008-2015.
Source: EU Member States DCF data submission

Total income in 2015 was €521 million, with a reduction of 11.5% compared to 2014. The total income is represented by 96% of turnover, 3% of other income and 1% of subsidies. Operating costs, on the other hand, fell by more than 24%, from around €490 million in 2014, to little more than €370 million in 2015. The contraction in operating costs is closely linked to a reduction in the use of raw materials, feed, as the volume of supply of goods has decreased. If looking at the overall period, after an increase in 2009, when the total income of the sector was about €639 million, a declining period has started. In the last 3 years the performance shows a significant upturn of total income: in 2014 an increase of 17% is registered if compared to the 2013, and on the total observed period the performance is positive (around +13%).

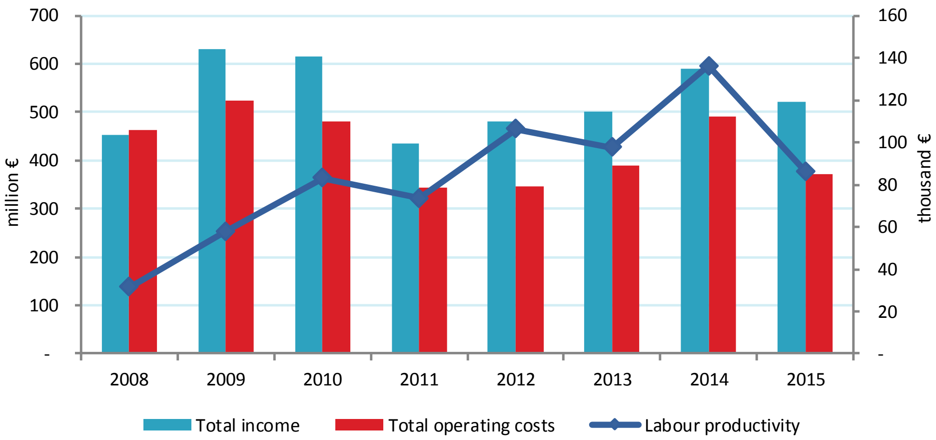


Figure 4.15.2 Income, costs, wages and labour productivity trends for Italy: 2008-2015.
Source: EU Member States DCF data submission

4.15.3 Economic performance

Total turnover increased from €566 million in 2014 to €498 million in 2015, thus reducing by 12%. although the sales performance was negative, it recorded a slight positive decrease, +2%, compared to 2008-2014. In 2015, the amount of subsidies collected by businesses is very low. They refer to the investment and financing balances obtained with the EFF. In 2015, EMFF funds have not yet been used. The total expenditure represents 71% of total income. The main operating costs are feed (25%), salaries (20%), fry (13%). Energy costs that in 2014 were more than 21% of operating costs have been (2015 year) 6%. Feed costs slightly increased (+2%) compared to 2014, as some species took longer to reach a commercial size (therefore they consumed more food).

Table 4.15.3 Economic performance of the Italian aquaculture sector: 2008-2015.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	*% of total income*	Change 2016-15	Development 2016/(2008-15)
Income (million €)											
Turnover	439.5	608.4	585.3	422.9	464.9	481.3	566.9	498.1	*96%*	*-12%*	*2%*
Other income	10.7	18.3	21.6	10.2	14.5	16.3	16.0	17.5	*3%*	*10%*	*-12%*
Subsidies	2.7	3.0	9.7	2.6	2.7	4.2	6.0	5.7	*1%*	*-6%*	*-22%*
Total income	*452.9*	*629.7*	*616.6*	*435.8*	*482.1*	*501.7*	*588.9*	*521.3*	*100%*	*-11%*	*2%*
Expenditures (million €)											
Wages and salaries	108.9	103.5	109.4	64.7	71.4	105.9	135.6	102.7	*20%*	*-24%*	*-3%*
Imputed value of unpaid labour	10.6	3.4	0.7	0.8	0.4	0.5	2.5	7.8	*1%*	*212%*	*-65%*
Energy costs	35.7	77.4	24.0	38.9	51.2	54.0	126.3	27.6	*5%*	*-78%*	*111%*
Repair and maintenance	16.4	32.7	8.7	15.4	25.3	23.6	35.5	14.9	*3%*	*-58%*	*51%*
Raw material: Feed costs	163.1	166.0	146.4	66.6	72.8	81.2	128.8	131.1	*25%*	*2%*	*-10%*
Raw material: Livestock costs	95.2	102.4	135.1	145.4	107.5	107.1	51.4	66.3	*13%*	*29%*	*60%*
Other operational costs	32.3	39.3	56.9	10.9	16.8	15.9	10.2	20.2	*4%*	*98%*	*29%*
Total operating costs	*462.3*	*524.7*	*481.2*	*342.8*	*345.3*	*388.3*	*490.3*	*370.5*	*71%*	*-24%*	*17%*
Capital Costs (million €)											
Depreciation of capital	19.8	32.0	35.5	19.5	22.0	20.4	24.5	28.1	*5%*	*15%*	*-12%*
Financial costs, net	36.5	13.0	16.7	6.7	6.8	8.2	11.7	7.5	*1%*	*-36%*	*90%*
Extraordinary costs, net	14.4	7.8	7.9	4.0	5.8	3.0	4.8	4.6	*1%*	*-3%*	*48%*
Capital Value (million €)											
Total value of assets	409.9	1409.0	1319.1	700.8	721.7	726.2	885.9	980.6	*188%*	*11%*	*-10%*
Net Investments	39.6	298.0	398.3	239.2	223.8	235.0	256.2	307.1	*59%*	*20%*	*-21%*
Debt	573.7	644.4	757.4	412.7	441.9	484.5	545.5	559.7	*107%*	*3%*	*-1%*
Input & Production (thousand tonnes)											
Raw material: Feed	170.6	161.1	117.7	98.2	79.3	60.4	104.2	112.7		*8%*	*0%*
Raw material: Livestock	176.6	45.8	54.0	32.6	30.6	24.1	33.2	19.5		*-41%*	*190%*
Performance Indicators(million €)											
Gross Value Added	107.4	208.9	235.8	155.8	205.7	215.8	230.7	255.5	*49%*	*11%*	*-24%*
Operating cash flow	-9.4	105.0	135.4	93.0	136.7	113.4	98.6	150.8	*29%*	*53%*	*-36%*
Earning before interest and tax	-29.2	73.0	99.9	73.5	114.8	93.0	74.2	122.7	*24%*	*65%*	*-42%*
Net profit	-65.8	60.0	83.2	66.9	108.0	84.8	62.5	115.2	*22%*	*84%*	*-50%*
Capital productivity (%)	26.2	14.8	17.9	22.2	28.5	29.7	26.0	26.1		*0%*	*-9%*
Return on Investment (%)	-7.1	5.2	7.6	10.5	15.9	12.8	8.4	12.5		*49%*	*-39%*
Future Expectation Indicator (%)	4.8	18.9	27.5	31.4	28.0	29.6	26.2	28.5		*9%*	*-17%*

Source: EU Member States DCF data submission

Compared to the cost of capital is detected, from 2008-2015, a general trend of decrease in both depreciation and financial costs, a factor which implies a reduction of investment in durable goods and, therefore, the resulting drop in bank credit demand. In 2015, companies have made little use of third-party capital, in fact the debt detected has increased by 3% compared to the previous year. In 2015, companies have made little use of third-party capital, in fact the debt detected has increased by 3% compared to the previous year. In the period 2008-2015 there is a low reduction of -1%. The Capital cost has signed an 8% incidence of total income. The GVA marks a good increase (11% more than 2014) and represents, in 2015, more than €255 million. EBIT was around €123 million, but fell by 65% over the previous year, but less than 42% related the long-considered period. Also, ROI is satisfactory compared to 2014, in fact in the year observed is 49%. ROI in previous year (2014) was 8.4%, while during 2015 it is 4 point more

(12.5%). This is an indicator of an industry of capital-intensive type, highly specialized both employed and of sophisticated technologies used. The high capacity for knowledge of aquaculture techniques, has a positive impact on productivity capacity (+26.1% in 2015) of the Italian sector. The level of capital productivity from 2008-2015 decrease around 9%. Considered the FEI, after the reduction in 2014, increase at level of 2012-2013, in fact during 2015 it is 28.5%.

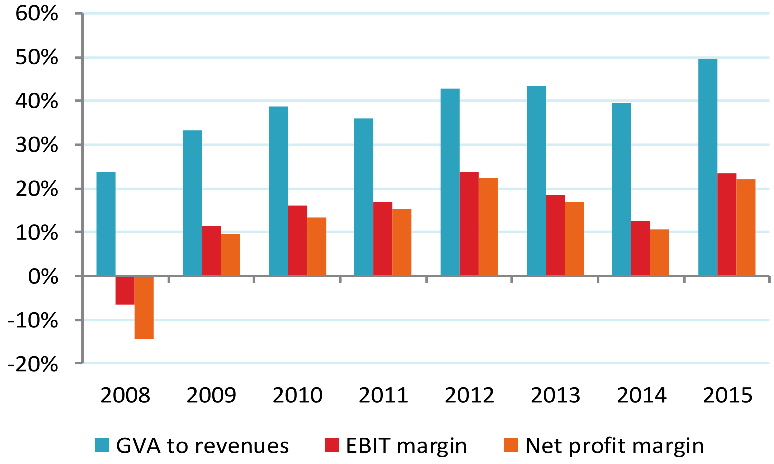


Figure 4.15.3 Economic performance for Italy: 2008-2015
Source: EU Member States DCF data submission

The GVA on revenues continues to generate a positive index, up 10 points from the previous year (2015 the rate is 50%). In addition, EBIT to revenue follows a very consistent trend with respect to the percentage of the observation period (2008-2015). The incidence of taxes can also be read in relation to the net profit margin that tends to contract.

4.15.4 Main species produced and economic performance by segment

The main species in volume farmed are for shellfish the Mediterranean mussels and Venus clams, while for the freshwater macro-aggregate the trout is the first cultured fish; finally, for the sector of euryhaline species the most farmed species is the seabream. On the hand of value, the most important species is the trout and the mussel are one of the last species. Unlike previous years, in the year 2015, the freshwater species is not, in terms of value, the driving force for the sector. The figure is affected by an environmental externality that negatively impacted production. Equally it happened to produce marine species. In general, the marine species segment enjoys greater stabilization of ex-farm prices, in how much the sea bass and sea bream offer is positioned in market segments that appreciate the made in Italy product. Moreover, based on the strategic choices of the organizations, the commercial size of the marine species is different from the import ones, and this allows to satisfy also and above all the Ho.Re.Ca.

The two figures shown refer to 2 different data collection periods. In 2016, not all segments detected can be compared with those of 2015. This is because the methodology was changed in 2016, in accordance with EUMAP. The performance below refers to the data by segment reported in 2016. The 4 main segments detected in EUMAP, the incidence of mussel (47% in volume, 35% in value), clam (17% in volume and 25% in value) trout (28% in volume and 27% in value) marine species (8% in volume and 13% in value) and remain unchanged. Evaluating ex-farm prices, the best performing species are marine species (SBSB), especially the commercial sizes over 500g, which have also been sold for more than €7.50 per kg. On average, SBSB have a price of €7.2 per kg. Mussels confirm a rather low ex-farm price of €0.65 per kg. In 2016 there is a fall in the price of mussels which in 2014 was €0.78 per kg. Price, however, already very low in past years and that continues to not improve, despite the profuse efforts of manufacturers to qualify production. Unfortunately, the product has been subject to unfavourable weather-environmental periods that have affected the level of quality of the offer, especially regarding edible meat. The trout are on average sold for just over €3.6 per kg the ex-farm price of the clams is €3 per kg. The price of clams decreased by more than 10% in 2016 compared to 2015, suffering the consequences of applying the minimum size of 25 mm. Even the volumes sold have been lower, especially due to the reduction of the product offer to commercial size.

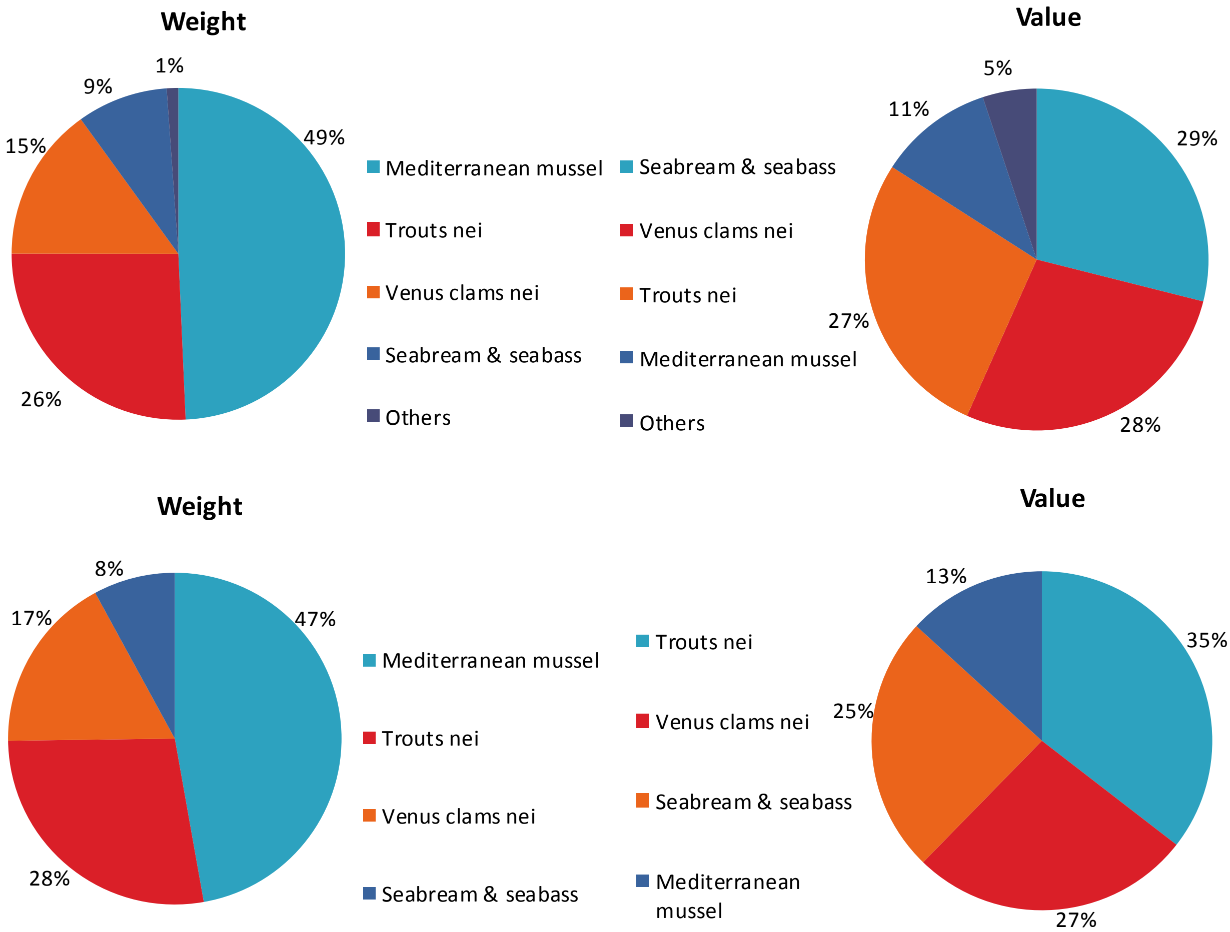


Figure 4.15.4 Main species in terms of weight and value in Italian production: 2015-2016.
Source: EU Member States DCF and EUMAP data submission

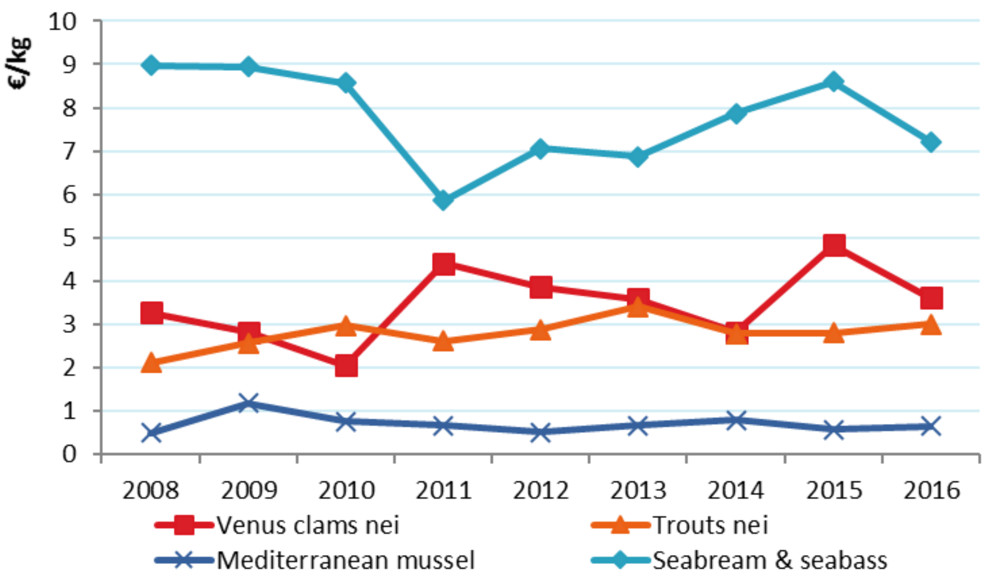


Figure 4.15.5 Average prices for the main species produced in Italy: 2008-2016.

Source: EU Member States DCF -EUMAP data submission

The methodological change allowed to collect data, in 2016, for five production segments, which report data for the four most produced species: mussels, clams, trout and marine species (seabream, seabass). By matching the DCF and EUMAP segments, three production segments have been considered equivalent since 2016, so it is possible to make an analysis using the 2008-2016 series. The following product segments is analysed:

- Segment 3.6: Seabass and seabream cages;
- Segment 10.10: Mussel long line;
- Segment 12.11: Clam on-bottom.

The reported histogram shows a drop of -38% in volume and -26% in value of "over species". The comparison is not statistically possible between 2015 and 2016 for the aggregation of other species, as it contains different production segments by number and type of technology. Therefore, only the perfectly comparable segments reported until 2015 (in agreement with the DCF) and for 2016 (under the EUMAP) will be considered.

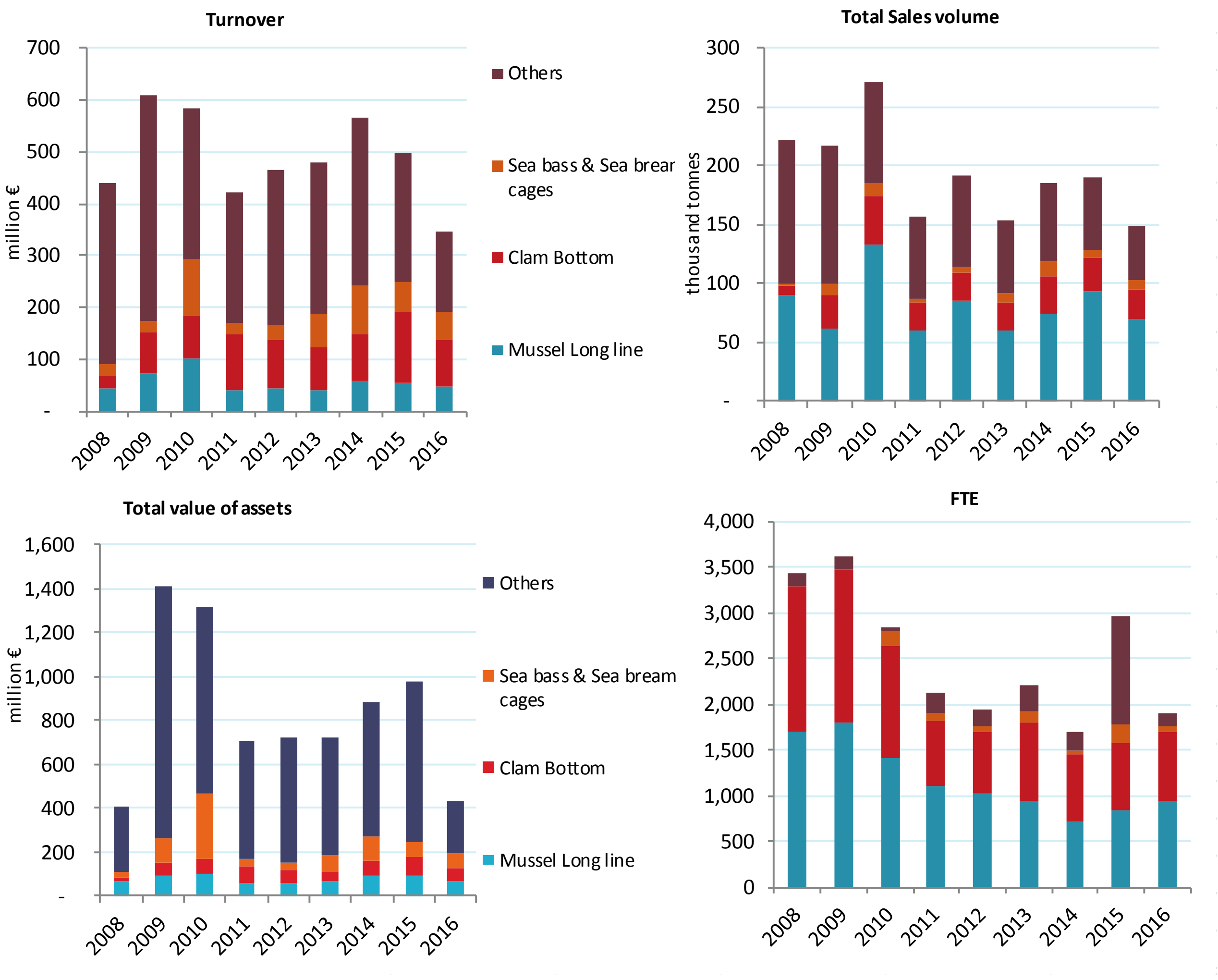


Figure 4.15.6 Structural development Italian aquaculture sector: 2008-2016.
Source: EU Member States DCF – EUMAP data submission

In 2016 the segment seabream and seabass (SBSB) in cages has growth of 9% in turnover and 10% in volume of sales. Both mussels and clams have been subject to contraction: clams, (-10% volume, and -33% of turnover) for reduction of available biomass higher than the commercial size that, until 2016, is 25 mm. Mussels have a reduction in volume of sales around 30% due to low abundance of commercial product in size. High temperatures caused the product to be caught ahead of time. It has been offered on the market in advance, and therefore cuts to smaller and with less quantity of edible meat. Furthermore, the volumes of products offered have been concentrated in a short time, so producers have been forced to further reduce ex-farm prices, and the turnover, during 2016, decrease more than 25% rather than 2015. The three segments (mussel, clam and SBSB in cages) aggregate over 93% of FTEs. The marine segment of SBSB in cages accounts for about 4% of FTEs in 2016.

Table 4.15.4 Economic performance of main Italian aquaculture segments: 2008-2016 (in million €).

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	*% of total income*	Change 2016/15	Development 2016/(2008-15)
Mussel Long line												
Total income	*47.8*	*77.9*	*106.1*	*41.4*	*44.6*	*41.6*	*61.1*	*58.2*	*46.4*	*100%*	*-20%*	*-22%*
Gross Value Added	*-3.9*	*26.7*	*21.5*	*18.8*	*21.1*	*21.7*	*11.0*	*34.6*	*18.1*	*39%*	*-47%*	*-4%*
Operating cash flow	*-30.1*	*-3.4*	*-10.6*	*9.2*	*13.4*	*7.4*	*-8.7*	*18.7*	*5.3*	*12%*	*-71%*	*1184%*
Earning before interest and tax	*-36.4*	*-7.5*	*-14.7*	*7.0*	*10.3*	*4.4*	*-13.5*	*13.1*	*2.1*	*4%*	*-84%*	*144%*
Net profit	*-37.4*	*-8.1*	*-15.7*	*6.5*	*9.7*	*3.4*	*-14.6*	*12.5*	*1.6*	*4%*	*-87%*	*130%*
Total sales volume (thousand tonnes)	*90.5*	*62.3*	*133.8*	*59.6*	*85.5*	*60.3*	*74.5*	*93.6*	*70.0*		*-25%*	*-15%*
Clam Bottom												
Total income	*25.4*	*79.1*	*90.5*	*107.7*	*98.2*	*88.8*	*99.1*	*146.3*	*98.1*	*100%*	*-33%*	*7%*
Gross Value Added	*4.0*	*48.5*	*80.2*	*18.2*	*16.6*	*25.2*	*86.9*	*135.7*	*72.3*	*74%*	*-47%*	*39%*
Operating cash flow	*-2.6*	*38.6*	*73.4*	*5.1*	*3.3*	*-6.6*	*34.3*	*90.9*	*44.6*	*45%*	*-51%*	*51%*
Earning before interest and tax	*-4.2*	*37.4*	*71.4*	*1.5*	*1.8*	*-8.3*	*31.7*	*89.0*	*42.3*	*43%*	*-52%*	*54%*
Net profit	*-4.6*	*36.2*	*70.5*	*0.6*	*1.3*	*-9.0*	*30.9*	*88.4*	*42.0*	*43%*	*-52%*	*57%*
Total sales volume (thousand tonnes)	*7.4*	*27.1*	*40.0*	*24.1*	*24.0*	*23.1*	*31.2*	*28.6*	*25.6*		*-10%*	*0%*
Sea bass & Sea bream cages												
Total income	*21.0*	*27.8*	*116.0*	*22.3*	*31.2*	*65.6*	*98.5*	*62.0*	*54.0*	*100%*	*-13%*	*-3%*
Gross Value Added	*9.2*	*0.2*	*23.5*	*8.8*	*14.9*	*21.9*	*18.2*	*20.4*	*24.3*	*45%*	*19%*	*66%*
Operating cash flow	*7.3*	*-8.5*	*9.8*	*6.6*	*12.8*	*15.9*	*10.1*	*14.0*	*19.7*	*36%*	*41%*	*131%*
Earning before interest and tax	*6.1*	*-13.4*	*-0.4*	*5.4*	*11.6*	*13.4*	*7.1*	*11.2*	*17.7*	*33%*	*59%*	*245%*
Net profit	*5.7*	*-14.0*	*-6.5*	*5.2*	*11.2*	*12.7*	*6.7*	*10.9*	*17.4*	*32%*	*59%*	*337%*
Total sales volume (thousand tonnes)	*1.7*	*9.9*	*12.2*	*2.7*	*3.8*	*9.1*	*12.8*	*6.4*	*7.1*		*10%*	*-3%*
Trout on growing												
Total income	*66.0*	*52.2*	*21.3*	*117.0*	*157.6*	*127.8*	*106.2*	*114.3*				
Gross Value Added	*22.7*	*10.7*	*6.4*	*44.6*	*78.4*	*58.1*	*28.6*	*26.4*				
Operating cash flow	*9.2*	*5.1*	*3.3*	*29.2*	*60.3*	*42.2*	*19.0*	*11.9*				
Earning before interest and tax	*8.4*	*2.6*	*0.9*	*24.2*	*54.6*	*38.0*	*15.7*	*3.3*				
Net profit	*7.3*	*0.2*	*-1.7*	*22.6*	*52.8*	*35.8*	*13.7*	*1.2*				
Total sales volume (thousand tonnes)	*33.6*	*12.1*	*6.6*	*40.7*	*51.0*	*35.4*	*36.5*	*39.2*				
Sea bass & Sea bream on growing												
Total income	*87.3*	*11.4*	*27.0*	*26.1*	*29.9*	*26.7*	*46.9*	*83.4*				
Gross Value Added	*19.9*	*0.6*	*10.6*	*23.8*	*22.3*	*19.9*	*13.5*	*25.9*				
Operating cash flow	*3.6*	*-1.4*	*5.7*	*16.4*	*16.0*	*12.5*	*4.4*	*16.7*				
Earning before interest and tax	*-1.6*	*-2.8*	*5.1*	*15.1*	*14.0*	*11.0*	*2.6*	*13.7*				
Net profit	*-4.3*	*-2.9*	*4.9*	*14.9*	*13.8*	*10.8*	*2.2*	*12.6*				
Total sales volume (thousand tonnes)	*9.5*	*1.5*	*3.8*	*5.1*	*4.2*	*3.7*	*5.6*	*9.9*				
Other freshwater fish on growing												
Total income	*29.3*	*49.2*	*31.5*	*67.5*	*81.9*	*107.3*	*124.8*	*25.7*				
Gross Value Added	*6.6*	*10.8*	*10.1*	*28.7*	*46.5*	*62.6*	*59.9*	*8.8*				
Operating cash flow	*-19.8*	*4.0*	*-0.4*	*18.8*	*29.9*	*42.3*	*31.7*	*2.2*				
Earning before interest and tax	*-20.1*	*0.4*	*-2.8*	*15.4*	*25.9*	*37.1*	*25.3*	*0.2*				
Net profit	*-20.8*	*-1.2*	*-5.7*	*13.3*	*23.6*	*34.3*	*20.0*	*-0.2*				
Total sales volume (thousand tonnes)	*4.1*	*2.7*	*1.9*	*7.6*	*11.6*	*13.8*	*14.5*	*2.1*				

Source: EU Member States DCF and EUMAP data submission

The mussels and clams' sectors are characterized by a complex structure in which still live old traditions and modern capital-intensive farming techniques. Shellfish industry actually, represents the main item production of the national sector, although the production is based almost exclusively on mussels (*Mytilus galloprovincialis*) and clams (*Tapes philippinarum*), limited quantities of clams (*Tapes decussatus*) and oysters (*Crassostrea giga* and *Ostrea edulis*). Starting from 2015, we note the presence of a modernization in the mussels' sector. There are boats that are purification centres for mussels. As well as serving the daily activities of support for offshore installations, they are also centres that store the product to purify it and then place it on the market (through shipping centres). The presence of purification ships has affected the energy costs of mussels, but it represents a willingness of producers to make a change to introduce the vertical integration of production. With about 70 thousand tonnes in 2016, mussels represent the first sector in Italy. Although the supply of traded volumes is high, the segment in economic terms contends not to be driving, nor competitive to attract capital.

The first Italian segment in terms of total income, is represented from clam on bottom (€98.5 million), followed from seabass and seabream farmed in cages with around €54.4 million and mussel is the 3th in terms of total income (€47 million). The segment while producing significant volumes of product, mussel, is the one with a worse economic performance: a GVA of about €18 million, has recorded a net margin and a low EBIT, respectively €1.6 million and €2.1 million. During 2016, the ability to generate cash flow increased compared to 2014, when it was negative. In 2016 it rose to €8.4 million, representing a decrease compared to 2015, when it was over €18.5 million. An improvement in performance compared to 2014 and registered since 2015 has been the result of greater producer cohesion.

In Clams, the GVA was (2015) €136 million and in last year (2016) €72.5 million. The trend in 2016 compared to the previous year recorded the contraction generated by a crisis in the production sector that applied a clam fishing with different commercial sizes (25mm). In cascade, the other indicators also report and confirm for 2016 a decrease with respect to the previous year (GVA -47% compared to 2015) but not for the period 2008-2015, in fact, the GVA in 2016 was +39%. Clam performs confirm a growing trend for 2008-2016, although in 2016 all the values were down compared to 2015.

The total turnover for SBSB in the cage is €54 million, with a GVA of over €24 million. The segment can generate cash flow which is €19.7 million for 2016. All values are up compared to the period 2008-2015, the net profit. For the same period, the total income shows a slight decrease of -3%.

Segment 3.6: Sea bass & sea bream cages

The SBSB segment cages, represents the leading marine species segment in the national aquaculture economy. SBSB's sales volumes in crates are 7.1 thousand tonnes, which have increased compared to 2015, where it was 6.4 thousand. Companies that produce Italy are structured and invested heavily in capital. For over 4 years it has witnessed an aggregation of small businesses in medium-large holding companies. The aggregation also allows for greater trading capacity both for the purchase of raw materials and for the best commercial allocation of the offer. The companies of SBSB cages have the capacity to self-produce SBSB and to allocate the part of excess fry both domestic and foreign. The trend since 2016 is to push on seabream production compared to seabass. Until 2015, the productions for the two marine species were quite similar (50%). The trend is, however, for bream 65-70% of production and the remaining part is seabass. The prices in the segment are quite high, because the market rating differs from the import SBSB market. The fish from cages is appreciated by consumers, but mainly attacks the specialized catering sector. More than 40% of operating costs are covered by feed, followed by the purchase of fry (26%) and employee costs (salaries 14%). Energy consumption is aligned with the type of offshore activities and is less than 5%. The cost of labour decreased slightly by 3 percentage points compared to 2015. Workers in the segment are very specialized, there is an almost exclusive presence of men, and if there are women, they deal with activities exclusively on the ground, in the office. Where the companies have a nursery area for the reproduction of fry, there may be women, whose professionalism is medium to high. In the processing areas, there is usually a presence of women. The trend for the segment is to be limited to seasonal employees.

Starting from 2015, both the GVA on revenues and the net profit margin registered an upward trend, which in 2016 was, respectively, about the GVA on revenues of 41% and the net profit margin was (2016) 33%.

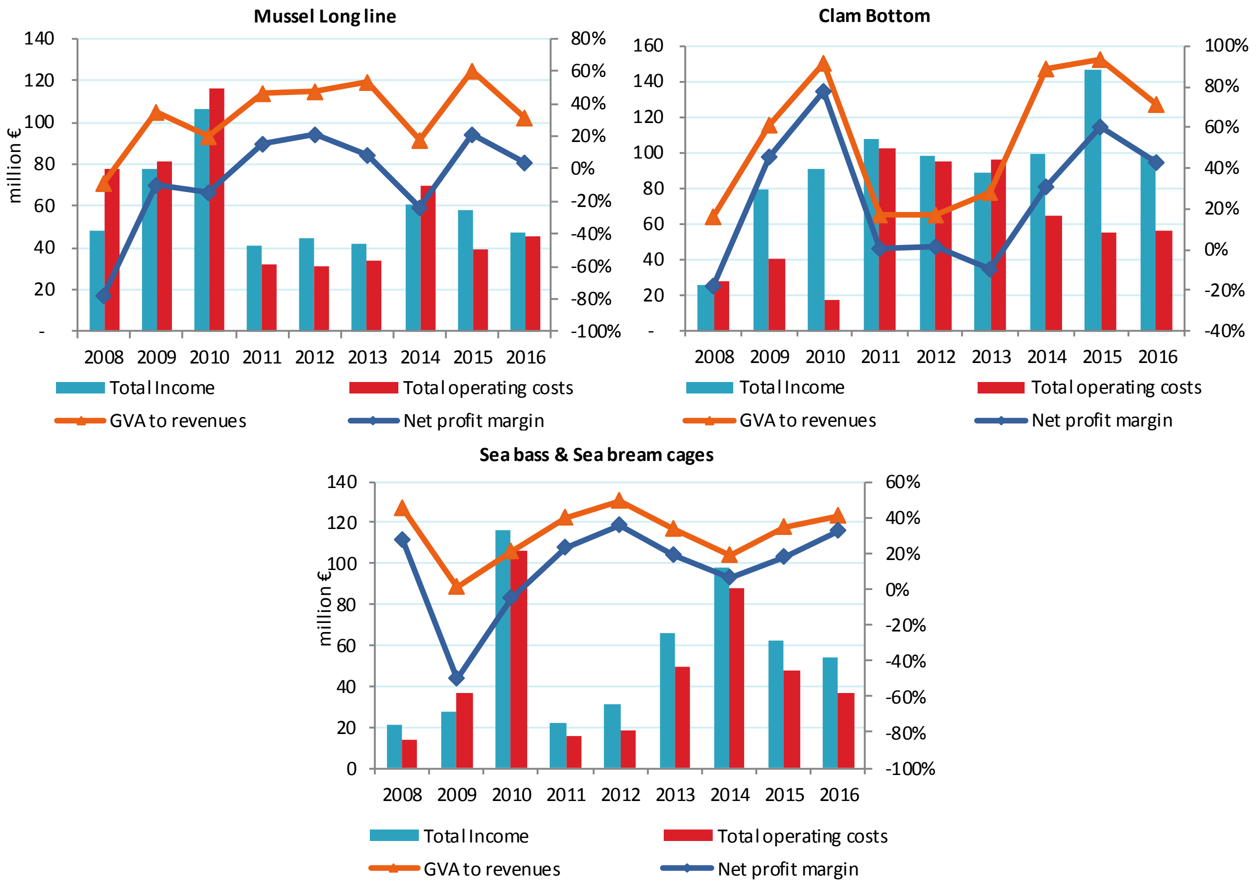


Figure 4.15.7 Economic performance indicators for the main Italian segments: 2008-2064.
Source: EU Member States DCF EUMAP data submission

Segment 10.10: Mussel long-line

Mussel is an important production, which puts the country in a leading position in Europe with a production of about 70 thousand tones. Mussel farming has a high dynamism. The market still has room for expansion, especially for oysters, for which, in 2016, new plants were set up that, in line with the Strategic Plan for Aquaculture (PSA), could boost production by 2020. In 2016 mussels are working on management of the mariculture areas to be allocated exclusively to mussels. The creation of "protected" marine areas for mussels is a goal that is expected to be reached by 2019, in line with the forecasts and actions reported in the PSA. Domestic production is not always able to meet the demand, also in relation to the seasonality of the supply that characterizes the national product. Production companies, based on the modest market value of the mussels and the expansion of farming into new areas, must meet the objective of maximizing production efficiency, focusing on the areas in which they deem the conditions most suitable from the point of view of the productivity parameters. The price, already particularly low, is affected, as it was in 2016, of external events that can promise the abundance of the volumes offered. In 2016, the price was among the lowest ever recorded for the mussel (less than €0.67 per kg). With the total turnover of about €47 million, GVA revenues amounted to 32% and net profit margin only 4%. With reference to production costs, the items of costs per seed and wages are equal in 2016, or about 29%, respectively. A significant item is energy consumption (20% in 2016) and this item is linked to production facilities. This value has been reported for quite some years with a rather high incidence, also compared with the values reported by the European countries that breed the same species with the same technology. The energy cost reported represents a trend to use the ships set up with the purification centers. The boats are also 20 LFT which means greater energy consumption.

Segment 12.11: Clam on bottom

The 2016 performance of clams has been low both for sales volumes (25.6 thousand tonnes) and for turnover, the price was affected by the dynamics of production (about €3.6 per kg). Some activities are under way at some Producer Organizations (PO) to certify the sustainable fishing product. It is hoped that the clams can be certified in the next two years. The Italian production of *T. philippinarum* is concentrated in the stretch of coast between Grado and the southern part of the Po Delta. In Italy, the annual needs of Philippine clam seeds are estimated to be at least ten billion units, more than 95% or which are taken in areas that have the calling for the establishment and development of juveniles of this species (nursery areas). The techniques of reproduction of Philippine clam have been consolidated for the past few decades. Analysing the items of operating costs in clam segment, more than 50% is absorbed from wage and salary. The FTE in 2016 is 741. The employed are seasonal so receive salary only for the period in which they work on the clams' farm; in the other words, in some phases some employees are the suppliers of raw materials and then are occupied into clams' farms. Energy costs (17% and maintenance costs (13% of operating costs) are linked to the vessels used for biomass collection. Related to GVA, clam segment showed a positive performance and the percentage of GVA to revenue is 71%, although positive, but decreasing compared to 2015 (when it was 93%). The net profit margin is higher than the other two production segments analysed previously, in fact in the segment it was, in 2015, 60% and in 2016 equal to 43%.

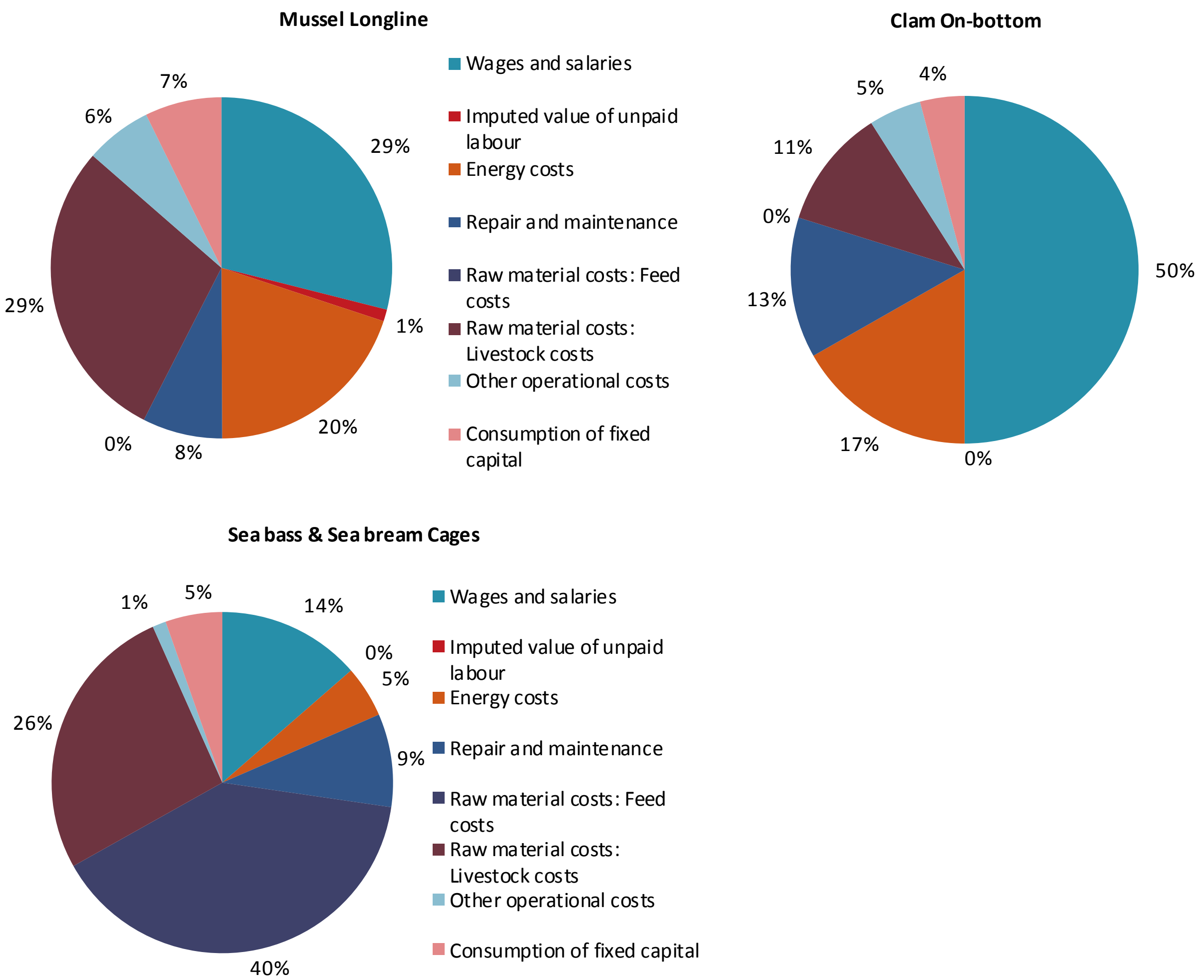


Figure 4.15.8 Cost structure of the main segments in Italy: 2016.
Source: EU Member States DCF-EUMAP data submission

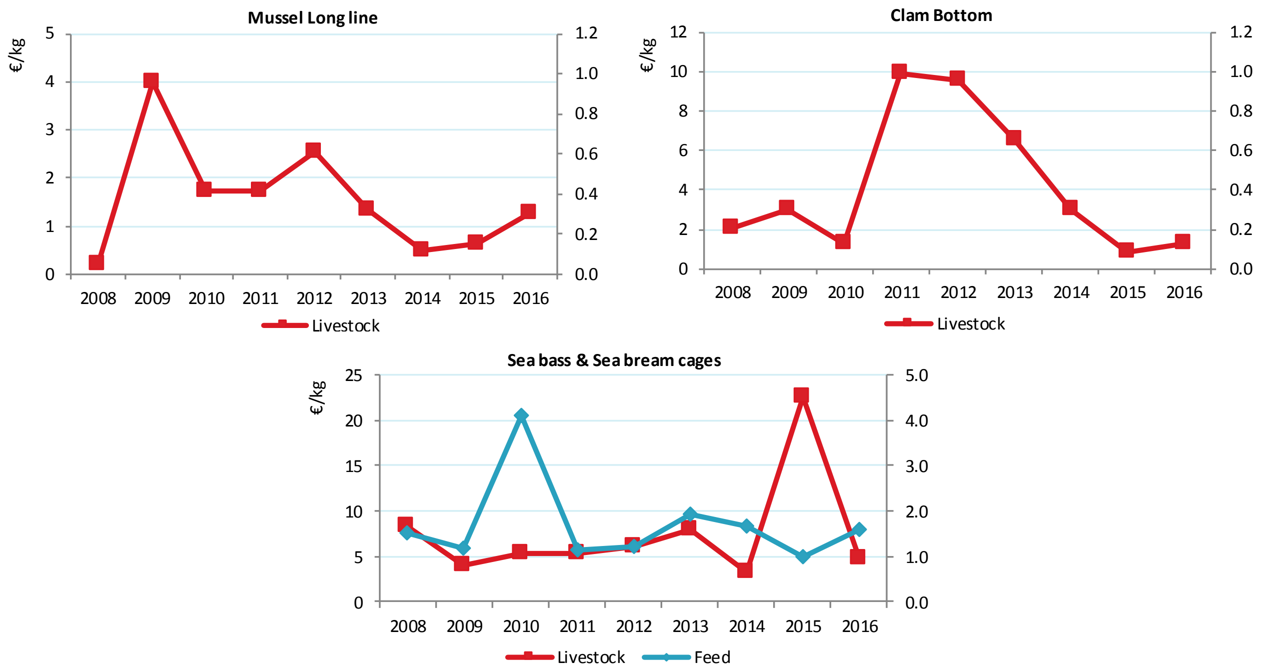


Figure 4.15.9 Feed and livestock prices for the main Italian Bulgariansegments: 2008-2016.

Source: EU Member States DCF-EUMAP data submission

The costs of the fry and feed are highly variable from one type to other farms. They depend mainly on the cultured species and technology. For marine cultured species, costs for feeds depend of the technologies in which are used: in off-shore cages, the risk is represented from a greater dispersion of the product, compared to what, for the same biomass bred, is used in the life cycle of inland farms. Moreover, the costs for fingerlings depend from the size of "seeding". Normally for fingerlings used in the cages, the average size is greater than those placed on the inland tanks, for so their cost is higher. In the case of mussels and clams, the cost item related to feed is completely absent. The values related, however, to the seed (livestock) are quite high. In the case of clams these values represent a share of the integration of the income of fishermen employed on plant. For the clams, Furthermore, the cost of the seed suffers fluctuations because strongly dependent on the availability of wild seed in the sea. In Italy it is increasingly important to identify the nursery areas to have an availability of wild seed clam.

4.15.5 Trends and triggers

Current production trends and main drivers

The trend of production is recovering, in terms of volumes produced and, consequently, of volumes sold. For the marine segment there is a concentration of supply and the organizations are investigating to test new technologies and search for high-performance feeds. For the shellfish aggregate, the trend is resuming, following the unfavourable conditions generated by climate change and the introduction of measures that led to the collection of 25mm-sized product. For the aqueduct segment, investigations are needed with respect to changes in river flow rates, which have caused many companies' inability to comply with the growth curves for the bred species. In some cases, it has not been possible, due to the limited amount of water, to produce, for example, the salmon trout.

Market structure

The market for marine species has oriented the production of companies. More bream is produced. The product has fewer spines and a less determined flavour, so it also pleases consumers, adolescents. In addition, the sea bass has a growth curve that is less performing than the sea bream, so it has a higher production cost, because it reaches a commercial size of more than 500 gram in more time. Marine species are heavily absorbed by the Ho.Re.Ca. rather than from the wholesale market and modern distribution (supermarket). The supply from fresh water allocates the product mainly in Germany, Austria and in a residual part in Switzerland and other countries of central Europe. It is estimated that about 40% of the offer of freshwater species is destined for consumption in a fresh format. Vertical integration is developing between trout and sturgeon organizations. The sale of caviar has not risen by any crisis (including for example the embargo with Russia), because it is almost totally absorbed by the Arab market. The Islamic market is of interest to trout producers, in fact there are already companies certified for slaughter according to Islamic protocols.

Issues of special interest

The sector continues to work to achieve the results already identified in the National Strategic Plan. A large part of the results has already been achieved to identify areas for the exclusive use of aquaculture (AZA), as well as surveys for the updated analysis of the state of well-being and abundance (or scarcity) of river water. No new facilities are expected on-land, so the sector that surely will be affected is freshwater. It is expected an increase in the production of fry of marine species, which are mainly sold in Italy and partly in the Mediterranean. This trend is different compared to 2014, where the main reference market for the sale of fry was the North African area.

Outlook for future production trends

Related to marine aquaculture sector, Italian strategic Plan highlighted the need to identify new areas for the marine aquaculture farms, and also the need to create a mapping with all the plants that already exist in Natura 2000 areas. In the NSP there are indications to push the marine aquaculture, which range from improving governance (the adoption of a general law devoted exclusively for aquaculture), to species diversification and technical innovation. Some indicators have been indicated in the NSP for aquaculture, i.e., organic production in the 2013 was around 250 tonnes, until 2025 will be auspicated other +500 tonnes. For marine fish production it will be estimated an increase to 576 000 tonnes in the 2030 and more than 1 000 new employees. The per capita consumption of aquaculture product will increase, in the 2013 it was around 4.2 kg per capita, in the 2025 around 6 kg/per capita. As regards allocated zone in the aquaculture, the ambition will be to obtain 20 there was any AZA. Following the Italian consumption habits of aqua-fish and the increase in per capita consumption of farmed fish that, in 2016, is over 6kg, producers are interested in new technologies and new markets. New technologies to safeguard the length of life of fresh products, especially for marine species. The marine sector only minimizes production to process (less than 2% of the total sold per year). Processed products of new conception, on the other hand, are required for the freshwater species. The target market is above all collective catering, especially school canteens, canteens of hospitals and pensions for the elderly. The mussel segment could be interested in strengthening the purification centres and starting processing lines, as in Italy bought both shelled clams and mussels and imported. The Turkish and Greek foreign product of marine species (SBSB) does not represent a competitor when it is purchased by consumers who are aware of the difference in quality, but who do not have high spending capacity for family consumption. For Italian consumers it is very important to recognize products in Italy, compared to imports, as Italian consumers recognize, also in terms of price, Made in Italy.

4.15.6 Data Coverage and Data Quality

Data quality

The methodology of the system "Probability Sample Survey", was used to draw the sample from the universe of aquaculture companies, for technical and production segment, according to a random selection.

- The segments, start from 2016, are 5 according to the following criteria: technology / species

- According EUMAP the segment with production less than 10% of total national volume are not jet collected

- Data samples in accordance with Appendix X must be expanded;

Structural data in Volume (tones) and Value (Euro) per segment (and here It must necessarily occur with the consistency of the data collected and sent to Eurostat according to Reg.762/2008). From analyses and verifications carried out on the data contained into the report, the consistency between Eurostat data and data DCF is not respected, because:

- Eurostat data are collected through a census of the aquaculture enterprises, while the DCF data are collected through a sample by production segment and then reported to the universe, with possible deviations from the actual value.
- Eurostat data (reg 762/2008) considers annual productions sold for consumption, while DCF data are obtained from the financial statements of companies and it is not possible to distinguish the component sold to the consumption from that sold to other aquaculture enterprises to complete the fattening final phase. Especially in the mussel sector and trout sector, it is in use the sale of products between facilities, with different specialization (juvenile, pre-growth and a commercial size) that can lead to an over-evaluation of the productions.

Related to estimation, the optimum sample number per stratum is defined according to Bethel's procedure (1989). Then, for each collected variable, to obtain the estimates of the totals per stratum, the Horvitz-Thompson formula is used, derived for the case of the simple random sampling without replacement. According to this estimator, the variance and the CV are calculated to evaluate the precision level. About the imputation of non-responses, there is a process of localization of errors. The control procedure of the survey can be considered as interactive graphic micro-editing of the univariate type. The term interaction refers to the fact that, in the procedure of localization of errors, there are not only automatic phases but also phases which require human intervention to investigate the situation and to evaluate the effective presence of the error (therefore the human intervention regards the localization phase and not that of imputation). The control is mainly of the univariate type because the variables are controlled individually. In rare cases are suspected relationships existing among them controlled, using suitable synthesis indexes. During the phases wide use is made of graphic tools to visibly evaluate situations marked as errors. Finally, the word micro-editing is used because the data is gathered in suitable domains of study within which the sampling units can be considered very homogenous. For each of these sets of data, suitable control functions are first calculated, and then, for each of them, certain rules of incompatibility are verified. In the case of activation of conditions of error, which is in the case where the observed value does not belong to the region of acceptance, those control functions are then observed individually for all the sampling units forming the single domain. Thus, the sample unit, or units, responsible for the activation of conditions of error is localized for the entire domain of study and then the imputation of the erroneous data follow.

Data availability

Data for the aquaculture sector is published once a year on both an aggregated farm and enterprise level for each segment.

Confidentiality

There are no confidentiality problems because the five segments include more than 20 companies. For some segments there is a high variability, therefore it was necessary to increase the number of the sample analysed.

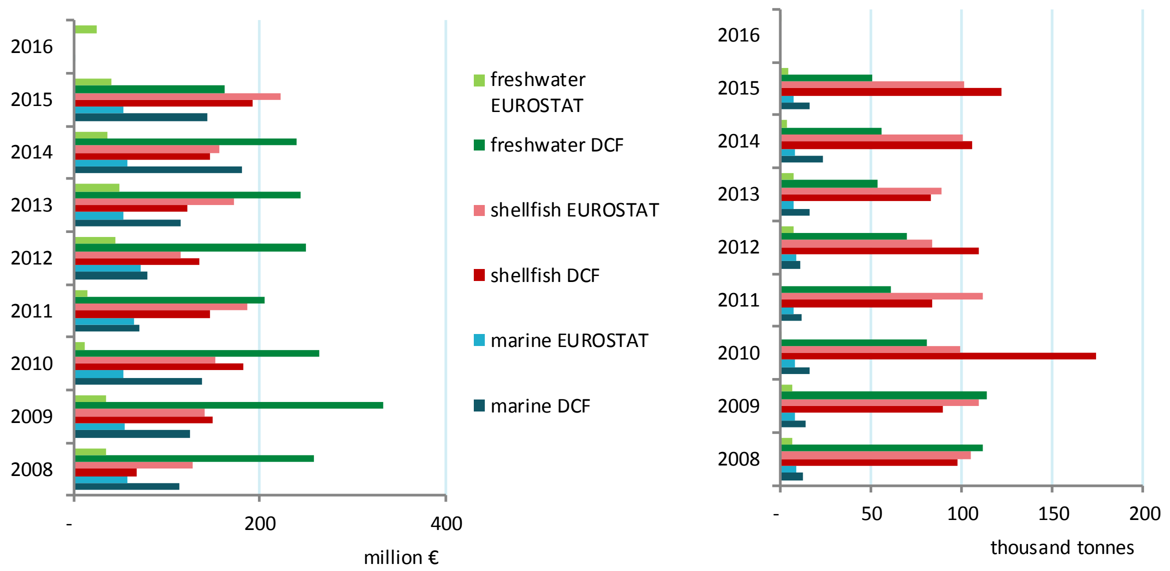


Figure 4.15.10 Comparison of DCF data with EUROSTAT data for Italy: 2008-2016

4.16 Latvia

4.16.1 Production and sales

Latvia produces no marine aquaculture (see Table 4.16.1 and Figure 4.16.2). The Latvian aquaculture sector produced 779 tonnes of in 2016. This production was valued about €2 million. The average price decreased significantly by 16% between 2010 and 2013 and was €2.5 in 2013. However, from 2014 the increase in average price by 30% was observed for the main production species.

During the period from 2008 to 2016 the aquaculture of Latvia developed in a generally positive direction the production capacity and productivity increased. However, the level of subsidies received by the sector also increased from 0.6 million in 2010 to €2.7 million in 2016. The subsidies on investment contribute 36% to the total subsidies in 2016.

The total Gross sales of production includes fish and crustaceans, prepared aquaculture production and juveniles sold during the year contributing 1.5 million tonnes and €5.6 million, respectively in 2016 (see Table 4.16.3). The total Gross sales increased significantly between 2010 and 2016 by 48%. In its turn, total Gross sales increased by 12% in value or by 169 in tonnes between 2015 and 2016.

Table 4.16.1 Production and sales for Latvia: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 15-16	Develop. 2016/(08-15)
Production weight (thousand tonnes)	*0,6*	*0,5*	*0,5*	*0,5*	*0,6*	*0,6*	*0,6*	*0,8*	*0,8*	*3%*	*30%*
Marine	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0%	0%
Shellfish	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0%	0%
Freshwater	0,6	0,5	0,5	0,5	0,6	0,6	0,6	0,8	0,8	3%	30%
Production value (million €)	*1,5*	*1,1*	*1,2*	*1,3*	*1,4*	*1,6*	*1,6*	*2,0*	*2,0*	*3%*	*38%*
Marine	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0%	0%
Shellfish	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0%	0%
Freshwater	1,5	1,1	1,2	1,3	1,4	1,6	1,6	2,0	2,0	3%	38%
Hatcheries & nurseries (million units)	*42*	*38*	*50*	*18*	*50*	*50*	*26*	*7*	*3*	*-57%*	*-91%*
Eggs	0	0	1	0	0	0	0	0	0	0%	-100%
Juveniles	42	38	49	18	50	50	26	7	3	-57%	-91%

SOURCE: EUROSTAT 2018

4.16.2 Industry structure and employment

In 2017, the number of registered aquaculture enterprises was 174. However, not all of them were economically active and farmed fish for the sale on market or produced young fish for restocking and on growing. About 90% of enterprises classified as small enterprises where the number of employments is less than 5 people. The significant changes in total value and volume can be observed during the data analysis due to the small number of enterprises involved in the aquaculture activity in Latvia.

During the previous decade between 2008 and 2016 the aquaculture production of Latvia reached its peak in 2016 – 779 tonnes in total volume or around 8% in average per year in monetary terms. The significant increase was in 2016 in the commercially valuable species items: carps and sturgeon breeding and sales an average quantity increase by 16% and 41% respectively compared to 2008. The trout turnover increased significantly by 8 times from 2008. The big share of the carp in aquaculture production is imported from Lithuania as well as trout and sturgeons have a significant share in the imported volume.

Production amount of aquaculture products are not restricted with quota or other restrictions, thus, in comparison to fishing, the initiation of business in this sector is simpler. As the number of the aquaculture companies increased, the number of the employees of the aquaculture companies increased as well – by 29% during the period 2008-2016. The specific weight of the total number of persons employed in aquaculture has increased from 177 in 2008 to 250 in 2016. The aquaculture mostly employs men and women aged from 40 to 64. At the enterprises in the main cases are employed the Latvian inhabitants. The work productivity in aquaculture is comparatively low. The average salary in 2016 was around €688 per month what only is by 8% higher than average salary in the country. The political and economic instability resulted in having relatively little impact on changes of employment level in the aquaculture sector compared to other sectors.

Table 4.16.2 Structure of the Latvian aquaculture sector: 2015-2016.

Variable	2015	2016	Change 2016/15
Structure (number)			
Total enterprises	*88*	*85*	*-3%*
<=5 employees	88	85	-3%
6-10 employees	0	0	
>10 employees	0	0	
Employment (number)			
Total employees	*236*	*250*	*6%*
FTE	168	169	*1%*
Indicators			
FTE per enterprise	1.9	2.0	*4%*
Average wage (thousand €)	12.2	12.2	*1%*
Labour productivity (thousand €)	9.4	16.5	*75%*

Source: EU Member States DCF-EUMAP data submission

4.16.3 Economic performance and indicators

The total income from the aquaculture generated by the Latvian aquaculture enterprises in 2016 was €7.7 million including €5.6 from gross sales per species and €2 million of subsidies. The turnover increased by 12% or by €0.6 million between 2015 and 2016.

The total operating costs decreased by 11% between 2015 and 2016 while the livestock costs and feed costs decreased significantly by 28% and 22% respectively.

The Energy costs contribute the largest share to the costs structure or 35% followed by the Wages and salaries and Feed costs with the shares 27% and 12% respectively (see Figure 4.16.1).

In terms of profitability the total amount of Gross Value Add (GVA), Operating cash flow and Net profit generated by Latvian aquaculture sector in 2016 were €2.8, €3.4 and €0.6 million respectively (see Table 4.16.3).

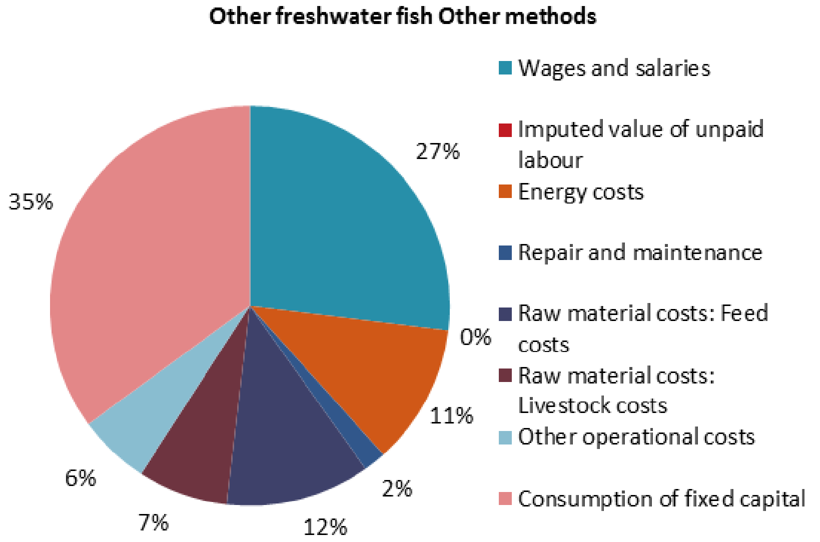


Figure 4.16.1 Cost structure of the main segments in Latvia: 2016.
Source: EU Member States DCF-EUMAP data submission

Table 4.16.3 Economic performance of the Latvian aquaculture sector: 2015-2016.

Variable	2015	2016	% of total income	Change 2016-15
Income (million €)				
Turnover	5.0	5.6	*73%*	*12%*
Other income	0.1	0.1	*1%*	*-19%*
Subsidies	2.0	2.0	*26%*	*-2%*
Total income	*7.1*	*7.7*	*100%*	*8%*
Expenditures (million €)				
Wages and salaries	2.0	2.1	*27%*	*1%*
Imputed value of unpaid labour	0.0	0.0	*0%*	*0%*
Energy costs	0.9	0.9	*11%*	*2%*
Repair and maintenance	0.1	0.1	*2%*	*-1%*
Raw material: Feed costs	1.1	0.9	*12%*	*-22%*
Raw material: Livestock costs	0.8	0.6	*7%*	*-28%*
Other operational costs	0.6	0.4	*6%*	*-28%*
Total operating costs	*5.6*	*5.0*	*65%*	*-11%*
Capital Costs (million €)				
Depreciation of capital	2.8	2.7	*35%*	*-5%*
Financial costs, net	-0.1	0.1	*1%*	*213%*
Capital Value (million €)				
Total value of assets	32.7	26.4	*344%*	*-19%*
Net Investments	1.2	1.5	*20%*	*28%*
Debt	13.1	11.6	*151%*	*-12%*
Input & Production (thousand tonnes)				
Raw material: Feed	2.1	2.3		*10%*
Raw material: Livestock	0.1	0.1		*-40%*
Performance Indicators(million €)				
Gross Value Added	1.6	2.8	*36%*	*76%*
Operating cash flow	2.1	3.4	*44%*	*66%*
Earning before interest and tax	-0.8	0.7	*9%*	*196%*
Net profit	-0.7	0.6	*8%*	*194%*
Capital productivity (%)	4.8	10.6		*118%*
Return on Investment (%)	-2.3	2.8		*218%*
Future Expectation Indicator (%)	-5.1	-4.5		*11%*

Source: EU Member States DCF-EUMAP data submission

4.16.4 Structure and performance of aquaculture segments

The section cannot be provided in whole detail due to the small number of enterprises in the aquaculture sector. The data was submitted according to the EU-MAP segmentation in table 9 as one segment "Other freshwater fish Other methods (seg.8.5)".

Main species produced

Common carp was the main species produced by the Latvian aquaculture sector; representing 72% in weight and 44% in value of total production in 2016 (see Figure 4.16.2). Other important fish species are Rainbow trout with 13% of the total value and 11% of the total weight.

Figure 4.16.2 Main species in terms of weight and value in Latvian production: 2016.
Source: EU Member States DCF-EUMAP data submission

The average first-sale price for aquaculture products in Latvia was €2.9 per Kg during the period 2008-2016 and for Common carp was €2.1 per Kg (see Figure 4.16.3). The high share of the common carp (representing 44% of the first-sale revenues) in the Latvian aquaculture leads average aquaculture prices down, compared to the other species that are more expensive. The average price for Rainbow trout and Sturgeons was €4.1 per Kg and €6.7 per Kg respectively in 2016.

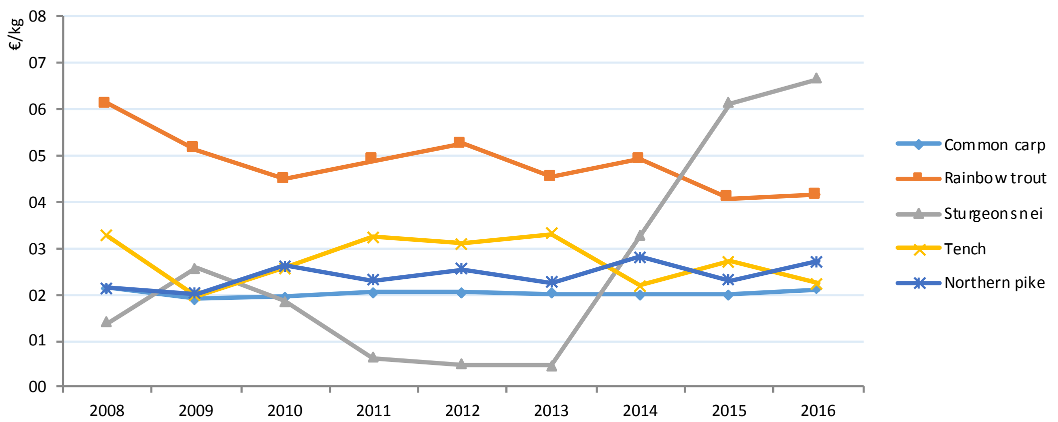


Figure 4.16.3 Price evolution of the main species of Latvian production: 2008-2016.
Source: EUROSTAT 2018

4.16.5 Trends and triggers

The investments in the modernization of aquaculture companies and introduction of new technological solutions increased significantly by 68% from 2008 to 2016 and were around €1.5 million in 2016. The total number of aquaculture companies focused on the market, raise the quality and safety of the produced production, as well as facilitate the extension of assortment of the produced production. Investments in the protection measures compensated losses caused by the wild predators, thus the production produced by the company will remain competitive in the market.

There are two main directions for fish farming in Latvia which will be developed:

- fish farming for consumption;
- fish breeding for fish restocking and reproduction in natural streams and lakes (fish recourses reproduction).

In addition to the National Fish resources restocking program the Latvian Fisheries Fund also supports fish and crayfish restocking in public waters. The state hatcheries restocked about 21 million of fish larvae, juveniles and smolts in Gauja, Venta, Daugava rivers and in the small rivers in 2017. For the fish cultivation in Latvian freshwater open land ponds annually are restocked about 12-26 million of fish larvae, juveniles and smolts.

The Institute of Food Safety, Animal Health and Environment "BIOR" is responsible for the implementation of the National Fish resources restocking program. In BIOR there are 5 State-owned Fish Hatcheries – Tome, Dole, Karli, Brasla, Pelci designated for breeding of salmon and sea trout smolts, pike, pike- perch, river lamprey larvae and juveniles. The program is established in order to ensure the fish fry compensatory releases to lower the damage to fish resources caused by Hydropower Stations as well as to restore damages and losses facilitated by different human activities in public water bodies. Every year they restock around 20 million fish larvae, juveniles and smolts in public waters, however, it is not sufficient; therefore, the private hatcheries should be involved as well.

One of the opportunities for private hatcheries is the specialization in fish resources restocking for public water bodies. Year by year the input of private hatcheries in restocking program is growing and varies from 10% to 25%.

The 43% of Latvian aquaculture enterprises are situated at Natura 2000 areas. These enterprises produce aquaculture production with applying environmental safety methods where recirculation systems are used. The enterprises received special licence from the State Environmental Service, which obligate to follow the environmental safety standards and should comply with Directive 2006/118/EU on the protection of groundwater against pollution and deterioration.

Further industrial processing of fish products from aquaculture is slowly developing in Latvia. The insignificant amount of sold aquaculture production provides evidence that only part from the companies produces goods for market. The big share of the aquaculture production is sold fresh. There is no trade system which would comprise and efficiently organize the traffic of aquaculture products supply from small private producers. More than half of the companies registered as aquaculture enterprises do not produced an aquaculture production for the market. Thus, it is difficult to provide constant and fixed amount and quality of the production supply.

However, the Aquaculture in comparison to other fisheries sectors has good development opportunities, due to decrease of fish resources in the sea, aquaculture shall be developed as an alternative source of fish resource. Latvia has good location of inland waters (lakes, rivers) and a stable ecologically pure environment. Amount of aquaculture production is not restricted by quota or other restrictions, thus, in comparison to fishery this sector offers more convenient initiation of business. Nonetheless, in comparison to neighbouring countries Latvia does not have so good climatic conditions for production of aquaculture products in the open land ponds (too warm conditions for the fish of cold waters and too cold - for the fish of warm waters). It may negatively affect in terms of production costs and affect the competitiveness of the industry in international level in the future.

In order to develop the aquaculture sector and for the organization of the studies since February 2016 operates the Aquaculture Research and Education Centre of Fish farm "Tome" of the Scientific Institute "BIOR". The aim of the studies is to share the experience in aquaculture as well as assistance in the modernization of the aquaculture enterprises.

4.16.6 Data Coverage and Quality

The Central Statistical Bureau of Latvia (CSB) carries out data collection for the aquaculture sector. The variables such as produced production by species in tonnes and value, total area of fish ponds, volume of rearing tanks and number of employments are included in the questionnaire form "1- Aquaculture". The questionnaire form was revised in 2014 and detailed information about income and costs, as well as investments and annual depreciation were included in the form according to the variable list provided in the table 7 COM 2016/1251. The first data for the new variables were received for 2015 and 2016.

The CSB gathers also structural business statistic data extracting the information from official account reports received from enterprises (according to the EUROSTAT definition under NACE Rev. code. 0322 "Freshwater aquaculture". Due to the small number of aquaculture enterprises and data confidentiality protection the collected data clustered in two segments by number of persons employed (more than 10 employees; less than 10 employees).

The quantity and value for production produced in Latvia are provided annually to the EUROSTAT in accordance with Regulation (EC) No 762/2008 of the European Parliament and of the Council of 9 July 2008 on the submission by Member States of statistics on aquaculture and repealing Council Regulation (EC) No 788/96.

The Gross sales per species in value and volume are provided according to the EU-MAP requirements in response to the Call for the data concerning the EU aquaculture sector 2008-2016.

4.17 Lithuania

4.17.1 Production and sales

Lithuanian aquaculture sector in 2016 produced 4.39 thousand tonnes (FAO, 2016) of total freshwater fish production from which 4.1 thousand tonnes were destined for consumption (Eurostat, 2016). The total value of production was €12.2 million in 2016, whereas production destined for consumption is valued for €10.9 million. Compare to 2015 total value of production increased by 13.6%. In Lithuania the total production value of aquaculture has been constantly increasing from 2008 with minor annual variations. However, quantity of production has also positive trend, but with more flat shape compare to value. For example, compare to 2008, volume of the total production increased by 46.0% in 2016, whereas value improved by 84.4% during the same period (FAO data). In Lithuania aquaculture production comes from two main aquaculture methods, pond aquaculture and RAS. Total volume of pond production declined by 3.2% whereas value increased by 11% compare to 2015. Different trend was observed in RAS units, where volume of production increased by around 20% and value by 33.5% compare to 2016.

Table 4.17.1 Production and sales for Lithuania: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 15-16	Develop. 2016/(08-15)
Production weight (thousand tonnes)	***3.0***	***3.4***	***3.1***	***2.9***	***3.2***	***3.8***	***3.4***	***4.1***	***4.1***	***0%***	***22%***
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Freshwater	3.0	3.4	3.1	2.9	3.2	3.8	3.4	4.1	4.1	*0%*	*22%*
Production value (million €)	***6.6***	***6.7***	***5.8***	***6.3***	***6.8***	***8.4***	***7.4***	***9.3***	***10.9***	***17%***	***53%***
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Freshwater	6.6	6.7	5.8	6.3	6.8	8.4	7.4	9.3	10.9	*17%*	*53%*
Hatcheries & nurseries (million units)	***155***	***138***	***1***	***8***	***13***	***15***	***16***	***11***	***12***	***8%***	***-74%***
Eggs	0	0	0	0	0	0	0	0	0	*0%*	*-100%*
Juveniles	155	138	1	8	13	15	16	11	12	*8%*	*-74%*

SOURCE: EUROSTAT

4.17.2 Industry structure and employment

Lithuanian aquaculture sector population in 2016 consisted from 54 aquaculture units. From the total population, 18 pond aquaculture enterprises belong to National producer organization (PO) and produced 90% of total national production and 86.4% of total value. Members of PO produce mainly carps and other polyculture freshwater species, as well as rainbow trout and sturgeons in tanks and raceways. In general, production of pond aquaculture in Lithuania could be considered as extensive. In 2016, around 24% of total pond production was certified as organically produced.

In 2016 Lithuanian aquaculture sector structure consisted from 9.67 thousand of ha from which 5.7 thousand ha were for regular production and 3.9 thousand ha were certified for organic production. Pond aquaculture units also exploit tanks and raceways which in 2016 were accounted for 8.9 thousand m3. Tanks and raceways are used to produce mainly trout and sturgeon. For example, 85% of total sturgeon production came from tanks and raceways.

In terms of number of enterprises, 57% of total population represents aquaculture producers, exploiting RAS. This part of sector is contributed with 10% of total national volume and 13.5% of total aquaculture value. In terms of target species, most RAS units produce African catfish and they are joined into producer organisation of alternative aquaculture. In 2016 capacity of RAS was extended to 7.8 thousand m3 from 6.2 thousand m3 in 2015.

In 2016, aquaculture sector employed 500 people from whom 388 were males and 112 females corresponding to 316 FTE. Total number of employees increased by 5.2% compared to 2015. In 2016 pond aquaculture units employed 359 persons, 4% lower compare to 2015, whereas RAS aquaculture units employed 141 persons, 37% more compare to 2015. The main driver of increase in the employment was establishment of new RAS aquaculture units, whereas pond aquaculture enterprises maintained more or less stable employment level during recent years.

Labour productivity in terms of value of production per employee 7.9% annual increase was observed in 2016. For example, in 2015 for the overall aquaculture sector one employee generated €22.7 thousand, and in 2016 it increased to €24.5 thousand. In RAS aquaculture units, labour productivity decreased by 4.3% from €12.2 thousand in 2015 to €11.7 thousand in 2016, whereas in pond aquaculture enterprises increase of 15.6% in labour productivity was observed, from €25.5 thousand in 2015 to €29.5 thousand in 2016.

4.17.3 Main species produced

In 2016 the most important species in terms of volume and value were carps from pond aquaculture. Carp production was accounted for 3.47 thousand tonnes in 2016 and compare to 2015 it decreased by 5.28%, whereas 23.1% of growth was observed compared to 2008. Production value of common carp increased by 6.58% compared to 2015 and by 44% compared to 2008. Carp sales contributed to around 80% of total national production in terms of volume and 69% in terms of value. The average first-sale price for common carp for consumption was €2.34/Kg whereas for on-growing purposes price of juveniles was €3.77/Kg. During long term period, from 2008 till 2014 carp prices remained relatively stable, around €2.0/Kg, but from 2015 it increased significantly, average price of total production in 2016 jumped to €2.43/Kg.

Around 70% of total carp production was sold in the Lithuania and 91.2% of it for consumption. Average price in the internal market was 19.15% higher compare to carp export price. The largest export market for carp in 2016 was Poland and Latvia with corresponding quantities 619 tonnes and 386 tonnes respectively. Export market share remained unchanged during recent years

Carps are usually grown in polyculture with other cyprinids as bighead carp, white amur, tench and other freshwater species as European pike and European catfish. Therefore, other freshwater species significantly contribute to the total aquaculture production. For example, in terms of production volume bighead carp was third top species after carp and rainbow trout. Bighead carps and white amur are mostly sold for further on growing purposes for individual farms, with less extent for consumption.

The second most important species are rainbow trout with annual production of 331.9 thousand tonnes in 2016 corresponding to value of €1.12 million. Trout production contributes to 7.8% of total volume and 9.1% of total value on national aquaculture production. Compared to 2015, rainbow trout production volume and value improved by 19.4% and 12.3% respectively. The vast majority of production comes from RAS, in 2016 it was accounted for 83.5% of total trout production. In 2016, the average rainbow trout price was €3.37/Kg and compared to 2015 it declined by 5.9%. Around 85% of production was sold in the internal market. The average price for trout sold in the internal market was €3.45/Kg and was 19% higher compare to the export price. The main export market for rainbow trout in 2016 was Poland and Latvia.

African catfish is one of the main species produced in the small scale RAS units. Number of African catfish producers has increased significantly from the 2012 when the first producers were registered. For example, in 2012, 3 units were producing African catfish with a volume of 13.2 t, whereas in 2016 it increased to 22 producers with production of 119 t and €384.9 thousand value. However, compare to 2015 African catfish production declined by 11.1%. Average prices for African catfish in 2016 was €3.23/Kg and compare to 2015 it decreased by 6.1%. Almost all production, around 96% was sold in the internal market in 2016, 27% of this production is supplied for processing in the aquaculture farms and sold with added value.

Increasing trend of sturgeon production was observed from 2008 with slight fluctuations depending on year. In 2016, aquaculture farms produced 126.6 tonnes of sturgeons, compared to 2015 production raised by 39.7% and compare to 2008 it increased by around 7.5 times. The average price for sturgeon in 2016 was €6.22/Kg and compare to 2015 it improved by 35.2%. Around 56% of total sturgeon production is sold in the Lithuania at average price of €5.31/Kg. For comparison, export price was €7.39/Kg. Differently from other aquaculture species, more than half (57%) of sturgeon production in the internal market is sold processed by aquaculture companies.

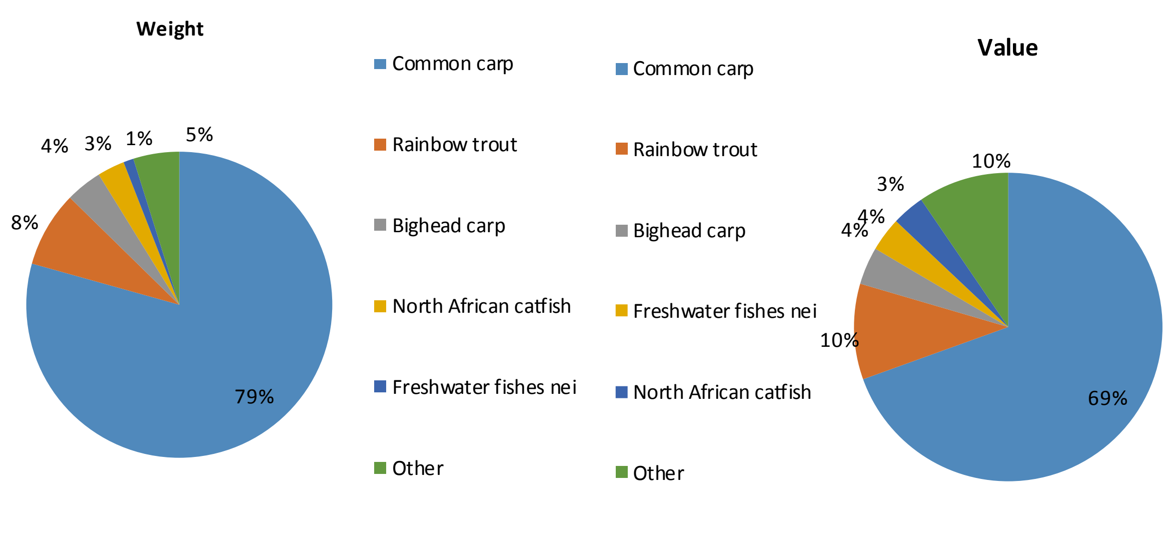


Figure 4.17.1 Main species in terms of weight and value in Lithuanian production: 2014.
Source: EUROSTAT

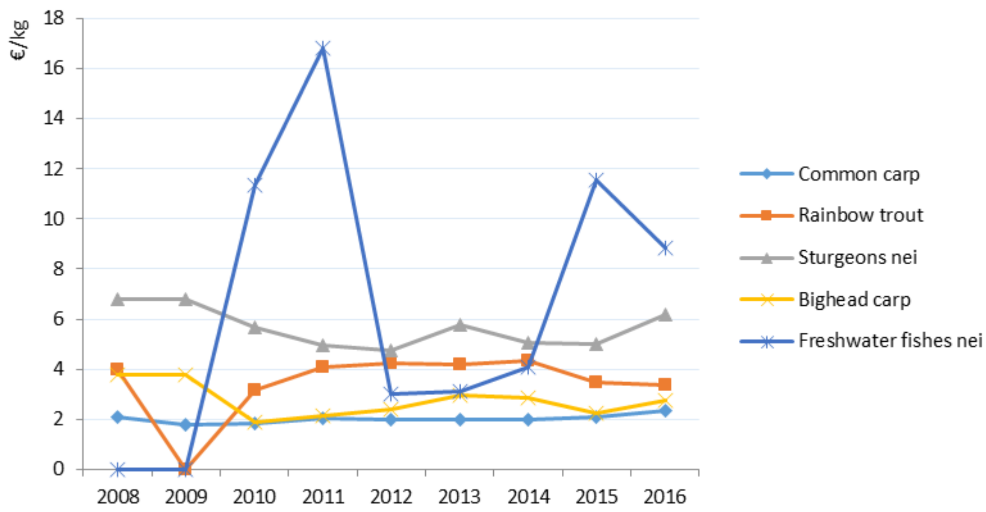


Figure 4.17.2 Average prices for the main species produced in Lithuania: 2008-2014.
Source: EUROSTAT

4.17.4 Trends and triggers

Current production trends and main drivers

From 2008 to 2016 total aquaculture production improved by 46% (FAO), whereas production value increased by 84.4%. Growth of production value is driven by recently increased prices of fisheries production in Lithuania internal market, significant part comes from added value by fish processing activities in aquaculture farms, fostered by EMFF support. One of the main drivers is steadily increasing consumption of fish and fisheries products per capita. One of the factors rising production value is diversification od aquaculture production with high vale species as European eel.

EMFF based investments boosted aquaculture production capacity through construction of new RAS farms, modernisation of existing pond infrastructure, also contributed to higher competitiveness.

However, increase in production value and volume was mostly driven by the internal market, whereas exports had a tendency to decline during from 2008 onwards. Above mentioned drivers for aquaculture sector has a limitation if export will remain at the current trend.

Market structure

In 2016 73.4% of Lithuanian aquaculture production is sold in the internal market. The rest part is exported, mainly to Poland – 57.3% of export sales and 36.6% to Latvia. The majority part of production is sold as fresh, mainly in supermarkets and directly from farms. The total aquaculture production in terms of destination, is divided to market for consumption and further growing purposes, when ex-farm production is sold at the size of juveniles. Around 6.7% of total production was sold as juveniles for further growing in 2016.

Outlook

According 2017 data (AIRBC), volume of aquaculture production decreased by around 15%, whereas value had only modest decline of 1%. Quantities of production from pond aquaculture decreased by 14% and value by 3% in 2017, whereas production from RAS units fell down by 25% but value increased by 11%. Deterioration of pond aquaculture was driven by extremely bad climate conditions when the level of average temperature in the growing season was too low to for growth of cyprinids and excessive rain during growing season increased water level in rivers which did not allow a proper harvesting of pond production. RAS production decline was related to the unexpected closure of business of the main large scale trout producers which were not being able to compete with imported trout production market. Further decline in the exports warns about the retaining of continuously improving aquaculture production trend. However, if aquaculture producers will be able to further increase production of higher value products from, eel, sturgeon, trout and catfish production by adding value with processing and at the same time will break through declining export trend, the goals, set in the Lithuanian 2014-2020 multiannual national plan for the development of sustainable aquaculture. The strengthening of local market is expected due to 2018 EMFF support for the UP5, objective 1 (Improving the organization of the market in fishery and aquaculture products) for national campaign on promoting consumption of fisheries products. Achievements is expected to contribute to further increase in the internal consumption of fishery products and increased sales.

Concerning structure of aquaculture sector in 2017, area of ponds remained the same compare to 2016, but capacity of RAS declined more than twice, from 7.8 thousand m3 in 2016 to 3.6 thousand m3 in 2017. It was related to the closure of two large scale trout producers and few small scale trout producers in RAS segment. According to preliminary data of 2018 (AIRBC), further decline by 11% of RAS capacity was observed and again due to the exit of large scale trout producer in RAS segment.

Due to the deterioration of RAS trout segment in 2017 and 2018, employment has steeply declined. For example, in 2017 total number of employees decreased by 13.6% compare to 2016 and further declined by 7% in 2018, compare to 2017.

4.17.5 Data coverage and quality

Lithuania only produces freshwater aquaculture and since freshwater aquaculture is not compulsory under the DCF, it did not submit aquaculture data under the DCF regulation. Therefore, FAO and EUROSTAT data were used in this analysis. Aquaculture production (sales) from Eurostat data covers only that part which is destined to consumption, whereas FAO data covers total production (sales) including juveniles which represents an important part of Lithuanian aquaculture sector. Data for 2017 is taken from published information by State Enterprise Agricultural Information and Rural Business Center (AIRBC), data is included to Official Statistics Programme of Lithuania).

4.18 Malta

4.18.1 Production and sales

The sector is solely dependent on marine fish aquaculture. In 2016, 13 656 tonnes of marine fish were produced by the Maltese aquaculture sector. Following the 5% decline of tones produced in 2014 compared to 2013, in the following two years, production increased significantly each year. In 2015 and 2016 sales weight increased by 26% each year when compared to the previous period. This was also reflected in the sales value, where sales from aquaculture productions in Malta amounted to over €127.9 (+32%) million in 2015 and €164 (+28%) million in 2016.

Table 4.18.1 Production and sales for Malta: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/ (08-15)
Sales weight (thousand tonnes)	*6.7*	*6.3*	*5.4*	*3.8*	*7.0*	*9.1*	*8.6*	*10.8*	*13.7*	*26%*	*89%*
Marine	6.7	6.3	5.4	3.8	7.0	9.1	8.6	10.8	13.7	*26%*	*89%*
Shellfish	0.0	0.0	0.0	0.0	0.0			0.0	0.0	*#DIV/0!*	*0%*
Freshwater	0.0	0.0	0.0	0.0	0.0			0.0	0.0	*#DIV/0!*	*0%*
Hatcheries & nurseries	0.0	0.0	0.0	0.0	0.0						
Sales value (million €)	*93.6*	*47.9*	*54.3*	*50.5*	*83.2*	*105.9*	*97.3*	*127.9*	*164.0*	*28%*	*99%*
Marine	93.6	47.9	54.3	50.5	83.2	105.9	97.3	127.9	164.0	*28%*	*99%*
Shellfish	0.0	0.0	0.0	0.0	0.0			0.0	0.0	*#DIV/0!*	*0%*
Freshwater	0.0	0.0	0.0	0.0	0.0			0.0	0.0	*#DIV/0!*	*0%*
Hatcheries & nurseries	0.0	0.0	0.0	0.0	0.0			0.0	0.0		

Source: EU Member States DCF-EUMAP data submission

4.18.2 Industry structure and employment

Six aquaculture enterprises operated in both 2015 and 2016. Only one enterprise had less than 5 employees, where each of the remaining enterprises employed more than 10 persons in 2015. In 2016 the employment structure recorded remained the same as the previous years, as 1 enterprise out of the 6 employed less than 5 persons and 5 employed more than 10. The number of employed individuals in the sector as from 2014 has been gradually increasing each year. Compared to the year prior, in 2015 employment increased by 8%, whereas in 2016 employment increased by 15%. Female participation in the aquaculture sector remains significantly low, as over the last 5 years, on average, Males represented 95% of the workforce over the last 5 years. Keeping in mind the increasing trend in employment in the Maltese Aquaculture sector, the average wage has decreased by 26% over two years, since 2014.

In 2016, the total number of persons employed in the Maltese aquaculture sector was 224, corresponding to 224 FTEs. The graph below shows an overall stable trend up until 2015, with slight fluctuations in the number of employees, for both males and females; however, in 2016 a slightly higher percentage increase was recorded. As similar to previous years, the average wage shows only small fluctuations, which is most probably driven by fluctuations in the number of employees, i.e. for the years in which the number of employees increase, the average wage decrease, while when the number of employees decreased, the average wage increase.

Table 4.18.2 Structure of the Maltese aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/ (08-15)
Structure (number)											
Total enterprises	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*0%*	*0%*
<=5 employees	0	0	0	0	0	0	1	1	2	*100%*	*700%*
6-10 employees	1	1	0	0	0	1	0	0	0		*-100%*
>10 employees	5	5	6	6	6	5	5	5	4	*-20%*	*-26%*
Employment (number)											
Total employees	*221*	*173*	*227*	*189*	*167*	*205*	*179*	*194*	*224*	*15%*	*15%*
Male employees	210	167	205	177	155	188	171				
Female employees	11	6	22	12	12	17	8				
FTE	169	145	161	165	153	178	153	194	224	*15%*	*36%*
Male FTE	160	141	152	158	148	167	148				
Female FTE	9	4	9	7	4	11	5				
Indicators											
FTE per enterprise	28.2	24.2	26.8	27.5	25.4	29.6	25.4	32.3	37.3	*15%*	*36%*
Average wage (thousand €)	24.0	25.2	20.4	18.1	23.1	19.2	23.1	20.5	17.1	*-17%*	*-21%*
Labour productivity (thousand €)	117.4	-137.6	95.5	84.0	-9.5	89.7	89.1	85.8	82.6	*-4%*	*59%*

Source: EU Member States DCF-EUMAP data submission

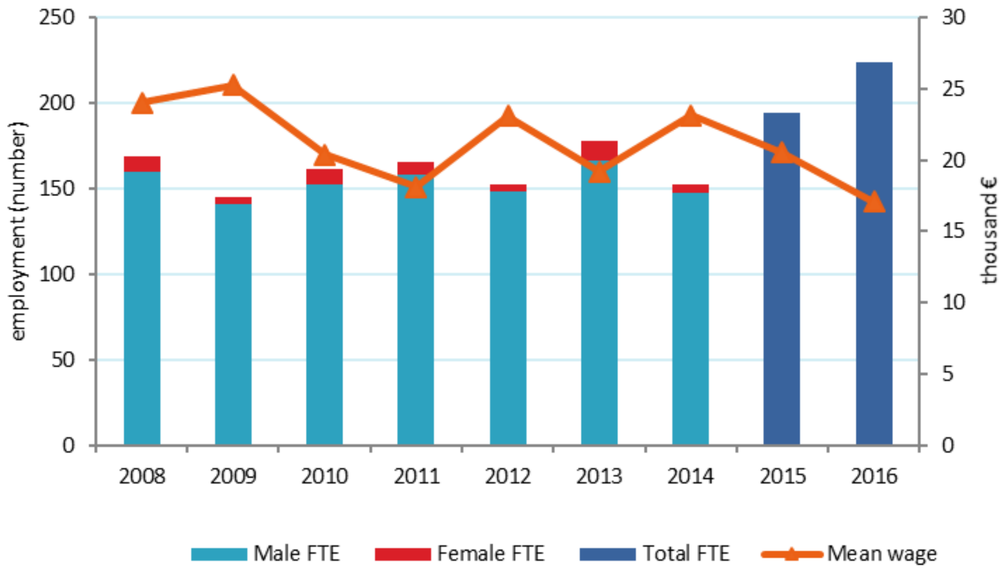


Figure 4.18.1 Employment trends for Malta: 2008-2016.
Source: EU Member States DCF-EUMAP data submission

The total income derives exclusively from the turnover from the sale of fish from the farms. The greatest cost component of the sector in 2016 was the cost of raw materials; feed (27%) and livestock (45%). Other operational costs, wages and salaries, energy costs and repair and maintenance followed in decreasing order. Labour productivity has remained fairly constant between 2013 and 2016, whereas GVA increased by 26% in 2015 and by 11% in 2016 when compared to the previous year.

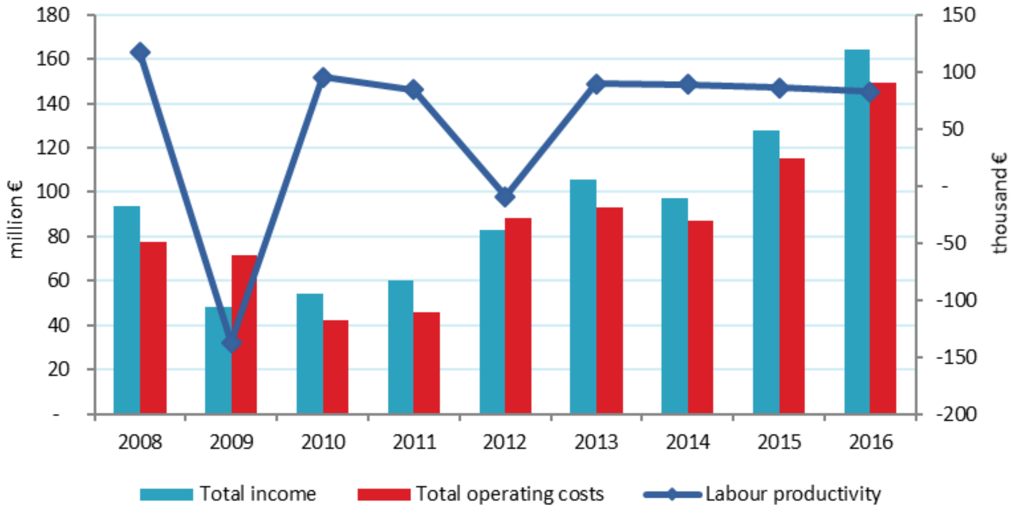


Figure 4.18.2 Income, costs, wages and labour productivity trends for Malta: 2008-2016.
Source: EU Member States DCF-EUMAP data submission

4.18.3 Economic performance

In 2016, total income increased by 28% when compared to 2015, this continues the positive trend which began in 2015 where another significant increase in income was recorded following the decline shown in 2014. total operating costs increased by 30%. Variations in expenditure, capital costs and capital value were observed when compared to previous years. These variations from year to year probably derived from the fact that the population is very small (only 6 enterprises in total) and thus any significant change in any of the enterprises would result in a large variation in data.

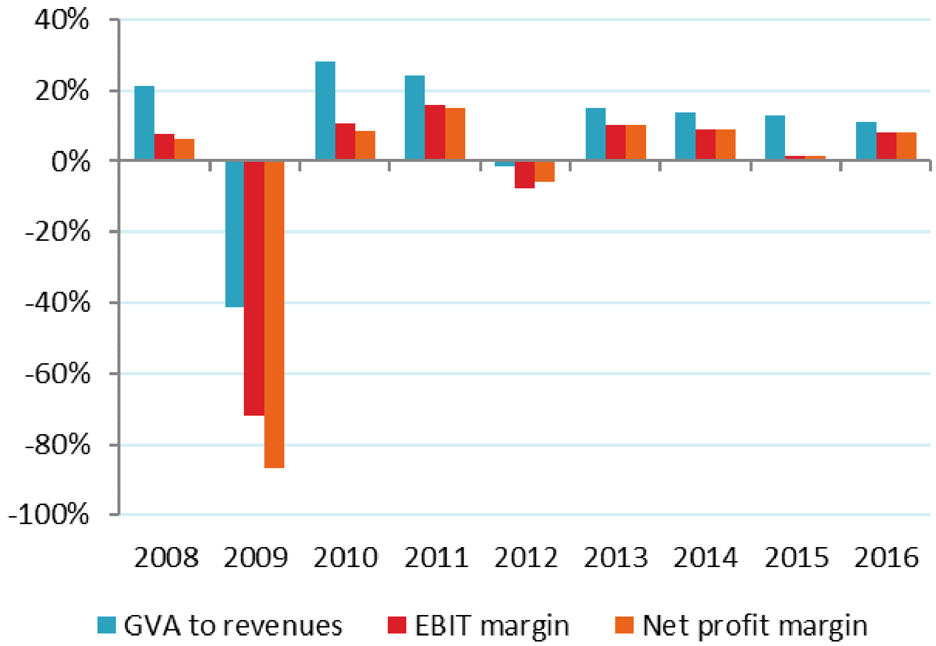


Figure 4.18.3 Economic performance for Malta: 2008-2016
Source: EU Member States DCF-EUMAP data submission

Table 4.18.3 Economic performance of the Maltese aquaculture sector: 2008-2014.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	*% of total income*	Change 2016-15	Development 2016/(2008-15)
Income (million €)												
Turnover	93.6	47.9	54.3	50.5	83.2	105.9	97.3	127.9	164.0	*100%*	*28%*	*99%*
Other income	0.0	0.2	0.2	6.4	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*	*-100%*
Subsidies	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*	*-100%*
Total income	*93.7*	*48.2*	*54.5*	*56.9*	*83.2*	*105.9*	*97.3*	*127.9*	*164.0*	*100%*	*28%*	*97%*
Expenditures (million €)												
Wages and salaries	4.1	3.7	3.3	3.0	3.4	3.4	3.5	4.0	3.8	*2%*	*-4%*	*8%*
Imputed value of unpaid labour	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	*0%*	*0%*	*-100%*
Energy costs	2.8	1.5	0.9	1.3	3.2	1.4	1.9	1.8	2.4	*1%*	*36%*	*31%*
Repair and maintenance	4.5	4.1	0.9	3.1	2.5	1.7	1.9	2.1	2.1	*1%*	*-3%*	*-19%*
Raw material: Feed costs	17.5	22.4	13.0	17.3	27.4	28.5	23.5	30.8	40.2	*24%*	*30%*	*78%*
Raw material: Livestock costs	30.9	24.4	13.1	11.1	40.7	44.3	39.3	58.7	67.1	*41%*	*14%*	*104%*
Other operational costs	18.0	15.7	11.2	10.3	10.9	14.0	17.2	17.8	33.8	*21%*	*90%*	*134%*
Total operating costs	*77.8*	*71.7*	*42.4*	*46.0*	*88.1*	*93.4*	*87.3*	*115.3*	*149.3*	*91%*	*30%*	*92%*
Capital Costs (million €)												
Depreciation of capital	8.8	11.1	6.3	1.9	1.5	1.5	1.4	10.7	1.3	*1%*	*-87%*	*-75%*
Financial costs, net	1.1	7.2	1.1	0.5	-1.4	0.3	0.0	0.0	0.0	*0%*	*0%*	*-100%*
Extraordinary costs, net	3.3	5.3	0.2	0.3	0.0	0.0	0.0					
Capital Value (million €)												
Total value of assets	18.7	17.5	13.7	10.7	9.5	29.9	29.0	26.9	26.4	*16%*	*-2%*	*35%*
Net Investments	4.1	0.9	1.5	0.4	1.1	3.7	1.0	2.2	1.6	*1%*	*-31%*	*-16%*
Debt	5.3	37.3	29.3	35.7	33.3	44.4	76.1	96.9	123.2	*75%*	*27%*	*175%*
Input & Production (thousand tonnes)												
Raw material: Feed	24.8	36.6	18.0	11.1	7.9	36.2	28.7	39.3	44.3		*13%*	*75%*
Raw material: Livestock	3.0	4.6	1.4	0.8	2.7	3.8	3.7	4.9	6.4		*31%*	*107%*
Performance Indicators(million €)												
Gross Value Added	19.8	-20.0	15.4	13.9	-1.4	15.9	13.6	16.6	18.5	*11%*	*11%*	*100%*
Operating cash flow	15.9	-23.5	12.1	10.9	-5.0	12.5	10.1	12.7	14.7	*9%*	*16%*	*157%*
Earning before interest and tax	7.1	-34.6	5.7	9.0	-6.4	11.0	8.6	1.9	13.3	*8%*	*595%*	*4436%*
Net profit	5.9	-41.8	4.6	8.5	-5.0	10.7	8.6	1.9	13.3	*8%*	*595%*	*1750%*
Capital productivity (%)	105.9	-113.9	112.0	129.0	-15.2	53.3	46.8	61.8	70.1		*13%*	*48%*
Return on Investment (%)	37.8	-197.4	41.9	83.5	-67.9	37.0	29.7	7.1	50.5		*609%*	*1525%*
Future Expectation Indicator (%)	-25.0	-58.2	-35.6	-13.7	-4.4	7.4	-1.6	-31.6	0.8		*103%*	*104%*

Source: EU Member States DCF-EUMAP data submission

The contribution to the national economy, measured as GVA, was positive in 2016 and 2015, with a start of an increasing trend over these two years. Net profit also remained positive with a significant increase between 2015 and 2016. In general, the contribution from the aquaculture sector has been positive seven out of the nine years covered by the DCF data. In contrast, the future expectation indicator has only been positive in two out of nine years, a positive indicator (0.8) has been predicted for 2016.

4.18.4 Main species produced and economic performance by segment

The largest segment in the Maltese aquaculture sector is the 'other marine fish cages', which mainly consist of Atlantic Bluefin tuna aquaculture and small contribution from the production of brown meagre and amberjack. The tuna is captured in the wild and fattened in the off-shore cages. A very minor amount of other marine fish species is also included. The second most important segment is the marine production of sea bass and seabream in cages.

On a regional scale, Malta attributes for a very low proportion in hatcheries and nurseries, and low volumes of seabass and seabream and other species except for bluefin tuna. Bluefin tuna fattening attributes for a significant share in the Mediterranean.

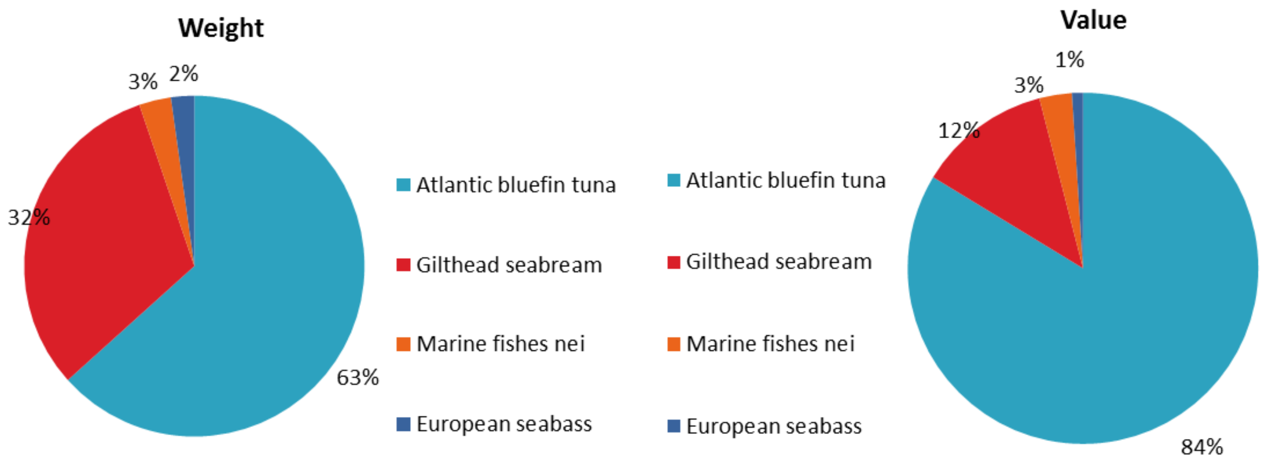


Figure 4.18.4 Main species in terms of weight and value in Maltese production: 2016.
Source: EU Member States DCF-EUMAP data submission

The top aquaculture species in Malta by first-sale weight were: Atlantic bluefin tuna (83%) followed by Gilthead seabream (16%). The other species (European seabass and other marine fish) accounted for 1% in weight. In terms of value, bluefin tuna sales dominated, attributing 93% of the value when compared with other species. This is mainly due to the fact that bluefin tuna are receiving very high prices especially in the Japanese market, which is the main market for Malta of this species. The second most important species was Gilt-head seabream with 6% of the value. Other species contribute only 1% to the total sales value.

The lowest average price per kilogram remained that for the Gilthead seabream and remained relatively constant over the past seven years. The price for European seabass tends to fluctuate over the years being reported, however due to the price increments recorded in 2015 and 2016, the gap between European seabass and Gilthead seabream seems to be slightly widening, once again. Atlantic Bluefin tuna received the highest prices. Since 2011, the average price has decreased and continued showing a decreasing trend since average prices in 2015 and 2016 showed further decline.

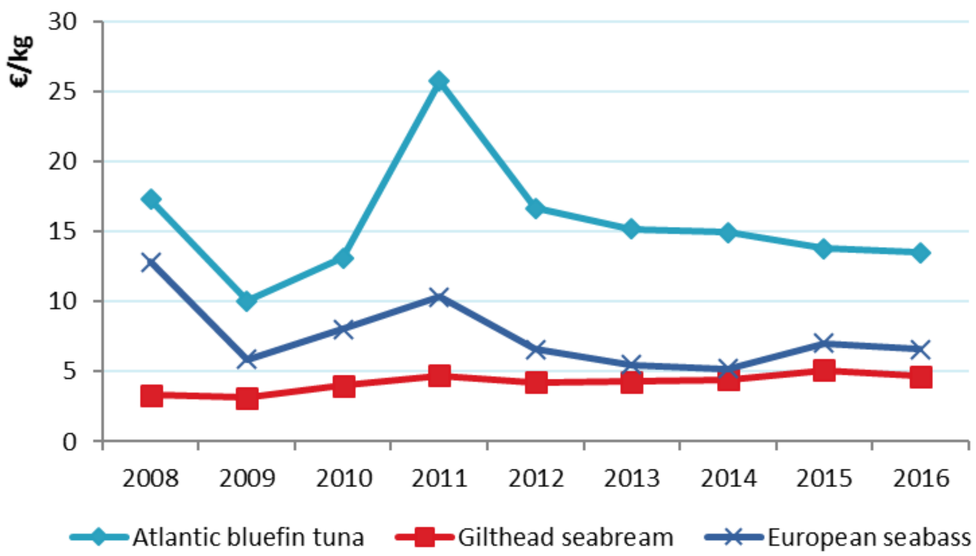


Figure 4.18.5 Average prices for the main species produced in Malta: 2008-2016.
Source: EU Member States DCF-EUMAP data submission

In Malta, the aquaculture sector is divided into two main segments, these being:

- Sea bass and sea bream cages
- Other marine fish cages

However, due to the limited number of enterprises (six in total) and few enterprises in other marine fish cages aquaculture, it is not possible to present data on these segments, due to confidentiality reasons.

4.18.5 Trends and triggers

The increases in TAC for Bluefin Tuna made in ICCAT recommendation 14-04 were a major driver for the positive growth of this segment for both 2015 and 2016. Further growth is expected from this decision as the TAC for tuna in 2017 will further increase the production capacity of the Maltese aquaculture sector operating in this segment. ICCAT recommendation 17-07 which looks to further increase by 20% (starting from 2018 to 2020) the TACs for Bluefin tuna in the Eastern Atlantic and Mediterranean, will continue supporting positive growth in the segment. Subsequently, this will result in higher sales weight and higher sales value but also in possible drops of the average price of Bluefin tuna.

Progress in research and innovation of the Maltese Aquaculture Sector as planned in the National Aquaculture Strategy may produce high outputs for other species at lower costs which may result in future growth and profits.

4.18.6 Data Coverage and Data Quality

The data showed that all employees, in the sector have worked full time, as the number of employees in the sector equates the FTE of the latter. In previous years this was not always the case.

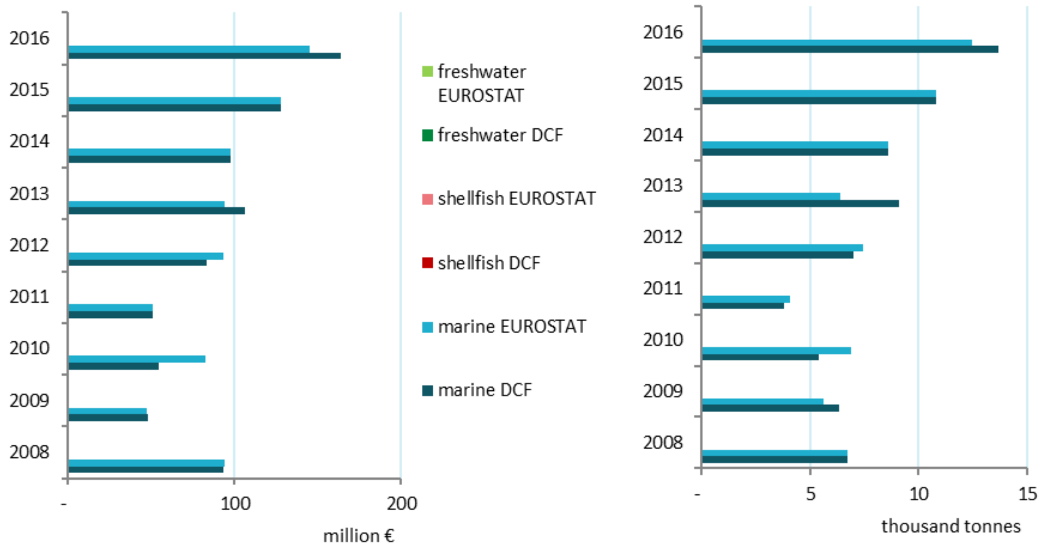


Figure 4.18.6 Comparison of DCF data with EUROSTAT data for Malta: 2008-2016

4.19 Netherlands

4.19.1 Production and sales

Dutch aquaculture is dominated by the shellfish sector, largest in sales weight and in sales value. Within this sector, blue mussels are the most important species.

Table 4.19.1 Production and sales for the Netherlands: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/ (08-15)
Sales weight (thousand tonnes)	*38.3*	*58.3*	*74.6*	*51.1*	*53.9*	*46.6*	*63.1*	*56.8*	*56.5*	*-1%*	*2%*
Marine											
Shellfish	38.3	47.9	60.4	40.8	43.9	40.1	57.4	56.8	56.5	*-1%*	*17%*
Freshwater		10.4	14.2	10.3	10.0	6.5	5.7				
Hatcheries & nurseries											
Sales value (million €)	*107.7*	*92.3*	*109.5*	*87.1*	*101.3*	*79.2*	*67.9*	*70.4*	*60.3*	*-14%*	*-33%*
Marine											
Shellfish	71.0	61.7	76.6	57.7	76.1	79.2	67.9	70.4	60.3	*-14%*	*-14%*
Freshwater	36.8	30.6	33.0	29.4	25.2	33.5	24.3				
Hatcheries & nurseries											

Source: EU Member States DCF-EUMAP data submission

In 2016 total sales weight decreased slightly with 1% to 56.5 thousand tonnes. Total sales value dropped with 14% to €60 million. The overall decrease in value is the result of increasing competition between the larger mussel growers/traders and the competition of mussel farmers in other MS.

Culture of shellfish is by far the largest activity. We differentiate between mussels (Mytilus edulis) and oysters (Ostrea edulis and Crassostrea gigas). The production of mussels has been stable during the years 2015 and 2016 (54 vs. 53 thousand tonnes, but total sales value decreased by 22% from €61 million to €47 million. Due to the growing use of the mussel seed collectors, the supply of mussel seed becomes more and more stabilized. The mussel sector is by far larger than the oyster sector (53 thousand tonnes compared to 3.3 thousand tonnes total sales volume in 2016). Oyster production started to decrease from 2013 onwards due to high mortality rates of Japanese oyster (Crassostrea gigas) larvae and spat caused by herpes disease and the exotic Japanese oyster drill (Ocenebra inornata). Production of shellfish takes place in the coastal areas with a concentration in the South-Western province of Zeeland and the Wadden Sea.

4.19.2 Industry structure and employment

The total FTE in the Dutch aquaculture sector (excluding the freshwater aquaculture) is estimated at 206 FTE. From 2015 to 2016, the number of employees has not changed. The aquaculture sector is dominated by men. The average FTE per enterprise has kept stable at 2.9 (based on shellfish aquaculture). In the mussel sector the number of FTE increased slightly (compared to 2008) due to the use of mussel seed collectors in this sector. Labour productivity decreased by 18%, mainly caused by the fall in labour productivity in the mussel sector (-31%). This increase reflects the lower sales value due to growing competition between the larger mussel farmers/traders and the competition of mussel farmers of other MS.

The number of enterprises and FTEs (for the shellfish aquaculture) has decreased from 2008 to 2016, but the average number of FTE per enterprise has grown in 2015/2016, due to the fact that mussel seed collectors bring more labour with them. The decrease in number of enterprises is largely the result of the exit of the smaller mussel companies. Over the last years, we have witnessed a slow but steady decline in the number of companies due to economic problems or retirement.

Table 4.19.2 Structure of the Dutch aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/ (08-15)
Structure (number)											
Total enterprises	*130*	*125*	*119*	*113*	*111*	*112*	*110*	*70*	*70*	*0%*	*-37%*
<=5 employees	124	118	112	106	104	104	103	66	66	0%	-37%
6-10 employees	6	7	7	7	7	8	7	4	4	0%	-40%
>10 employees	0	0	0	0	0	0	0	0	0		
Employment (number)											
Total employees											
Male employees											
Female employees											
FTE	215	388	364	340	350	199	205	206	206	0%	-27%
Male FTE	215	388	364	340	350	199	205	206	206	0%	-27%
Female FTE	0	0	0	0	0	0	0	0	0		
Indicators											
FTE per enterprise	1.7	3.1	3.1	3.0	3.2	1.8	1.9	2.9	2.9	0%	15%
Average wage (thousand €)	36.3	21.6	23.9	28.5	28.6	49.3	51.6	64.4	67.0	4%	76%
Labour productivity (thousand €)	298.9	101.7	170.4	138.8	154.0	265.2	206.4	209.9	172.4	-18%	-11%

Source: EU Member States DCF data submission

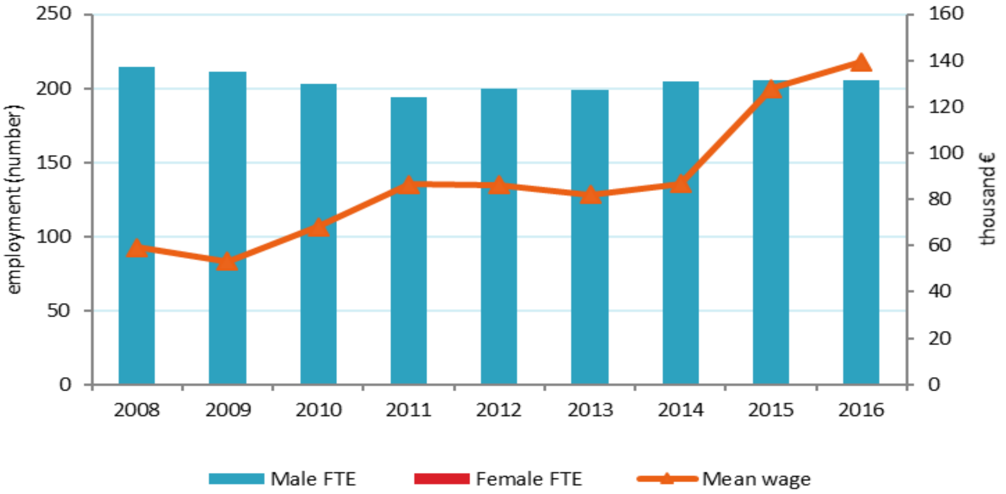


Figure 4.19.1 Employment trends for the Netherlands: 2008-2016.
Source: EU Member States DCF data submission

Figure 4.19.2 Income, costs, wages and labour productivity trends for the Netherlands: 2008-2016.
Source: EU Member States DCF data submission

4.19.3 Economic performance

From 2015 to 2016, total income decreased by 14%. Note that the income for 2015 and 2016 excludes the freshwater sector. The total income is dominated by the turnover from the sale of shellfish from the farms.

Table 4.19.3 Economic performance of the Dutch aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	*% of total income*	Change 2016-15	Development 2016/(2008-15)
Income (million €)												
Turnover	107.7	92.3	109.5	87.1	101.3	79.2	67.9	70.4	60.3	*95%*	*-14%*	*-33%*
Other income	9.2	6.1	4.2	1.6	2.2	2.8	2.9	4.0	3.5	*5%*	*-14%*	*-17%*
Subsidies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*	*0%*
Total income	*117.0*	*98.4*	*113.8*	*88.7*	*103.5*	*82.0*	*70.8*	*74.4*	*63.7*	*100%*	*-14%*	*-32%*
Expenditures (million €)												
Wages and salaries	7.8	8.4	8.7	9.7	10.0	9.8	10.6	13.2	13.8	*22%*	*4%*	*41%*
Imputed value of unpaid labour	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*	*-100%*
Energy costs	8.8	8.5	7.6	8.4	7.2	6.0	5.0	3.7	3.1	*5%*	*-17%*	*-55%*
Repair and maintenance	5.4	5.0	7.9	7.4	5.9	5.9	5.7	7.5	6.5	*10%*	*-13%*	*2%*
Raw material: Feed costs	14.2	12.4	9.8	7.5	6.9	0.0	0.0	0.0	0.0	*0%*	*0%*	*-100%*
Raw material: Livestock costs	12.3	11.6	7.3	8.2	5.8	2.7	2.7	3.0	3.0	*5%*	*0%*	*-55%*
Other operational costs	12.1	21.6	19.1	10.1	23.9	14.7	15.2	17.0	15.7	*25%*	*-8%*	*-6%*
Total operating costs	*60.6*	*67.4*	*60.5*	*51.2*	*59.7*	*39.2*	*39.1*	*44.5*	*42.1*	*66%*	*-5%*	*-20%*
Capital Costs (million €)												
Depreciation of capital	6.8	13.3	7.7	3.7	2.7	2.2	2.4	2.7	2.7	*4%*	*0%*	*-47%*
Financial costs, net	6.2	6.6	4.9	4.9	4.2	3.1	2.9	3.2	3.2	*5%*	*0%*	*-29%*
Extraordinary costs, net	0.5	2.5	0.6	0.2	0.2	0.2	0.2	0.1	0.1	*0%*	*0%*	*-88%*
Capital Value (million €)												
Total value of assets	179.1	174.4	94.1	96.0	97.1	107.1	110.3	135.4	135.4	*212%*	*0%*	*9%*
Net Investments	14.7	11.2	7.8	3.0	7.6	22.5	6.2	9.2	7.5	*12%*	*-18%*	*-27%*
Debt	118.6	105.4	94.6	89.6	79.7	82.2	76.3	111.5	111.5	*175%*	*0%*	*18%*
Input & Production (thousand tonnes)												
Raw material: Feed	0.0	11.1	9.9	10.2	9.4	0.0	0.0	0.0	0.0		*0%*	*-100%*
Raw material: Livestock	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0				
Performance Indicators (million €)												
Gross Value Added	64.1	39.4	62.0	47.1	53.8	52.6	42.2	43.1	35.4	*56%*	*-18%*	*-30%*
Operating cash flow	56.3	31.0	53.3	37.4	43.8	42.8	31.7	29.9	21.7	*34%*	*-28%*	*-47%*
Earning before interest and tax	49.6	17.7	45.6	33.7	41.1	40.7	29.3	27.2	18.9	*30%*	*-30%*	*-47%*
Net profit	43.4	11.2	40.8	28.8	36.8	37.6	26.3	24.0	15.7	*25%*	*-34%*	*-49%*
Capital productivity (%)	35.8	22.6	65.9	49.1	55.4	49.1	38.3	31.9	26.2		*-18%*	*-40%*
Return on Investment (%)	27.7	10.2	48.5	35.1	42.3	38.0	26.6	20.1	14.0		*-30%*	*-55%*
Future Expectation Indicator (%)	4.4	-1.2	0.1	-0.7	5.0	19.0	3.5	4.8	3.5		*-26%*	*-19%*

Source: EU Member States DCF data submission

For economic performance, 2013, 2014, 2015 and 2016 data is excluding the freshwater sector. The expenditures in 2016 are dominated by other operational costs (25%), wages and salaries (22%), repair and maintenance costs (10%) and energy cost (5%). Energy costs have decreased because of the lower fuel prices.

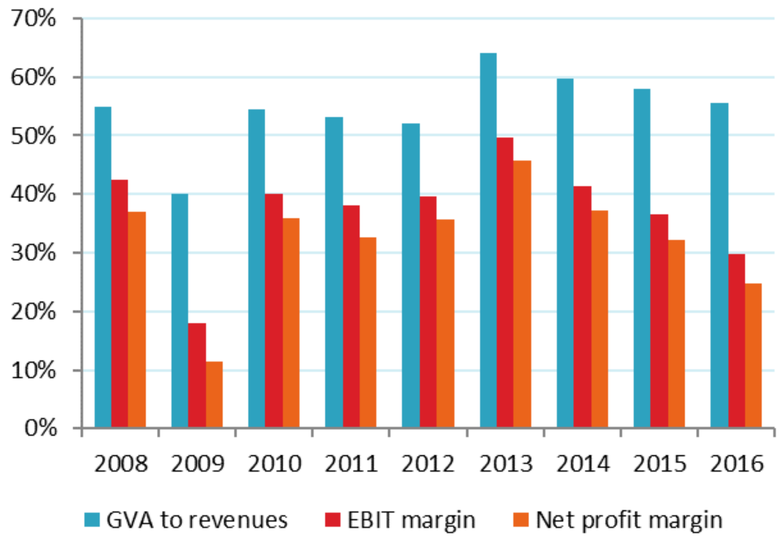


Figure 4.19.3 Economic performance for the Netherlands: 2008-2016
Source: EU Member States DCF data submission

The gross value added for the shellfish sector as a whole decreased by 18%, the EBIT decreased (30%) and net profit decreased (34%). The total value of assets remained the same in 2016 compared to 2015 (€135 million). The total level of debts remained the same as well (€112 million).

4.19.4 Main species produced and economic performance by segment

Aquaculture production in the Netherlands can be divided into three main segments:

- Segment 1: blue mussel on bottom cultures
- Segment 2: oysters on bottom cultures
- Segment 3: finfish, mainly European eel and North African catfish.

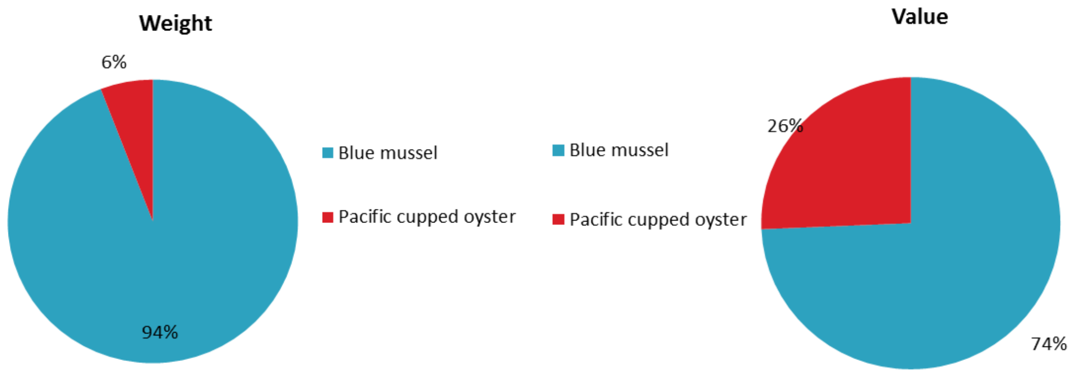


Figure 4.19.4 Main species in terms of weight and value in Dutch production: 2016.
Source: EU Member States DCF data submission

Segment 1: mussels on bottom cultures

Traditionally, the largest sector in Dutch aquaculture is mussels culture, consisting of 51 active companies. The data shows that total sales volume in 2016 was slightly lower (53.2 thousand tonnes) than in 2015 (54.1 thousand tonnes) (-1%). Sales value decreased by 22%: €57.3 million in 2015 and €44.8 million in 2016. Sales volumes are influenced by the collection of mussel seed in the 2-3 years before production. The increasing use of mussel seed collectors provides a more stable mussel seed production. In the Netherlands the mussel sector remains by far the largest aquaculture sector. Profit margin lays around 12% in 2016.

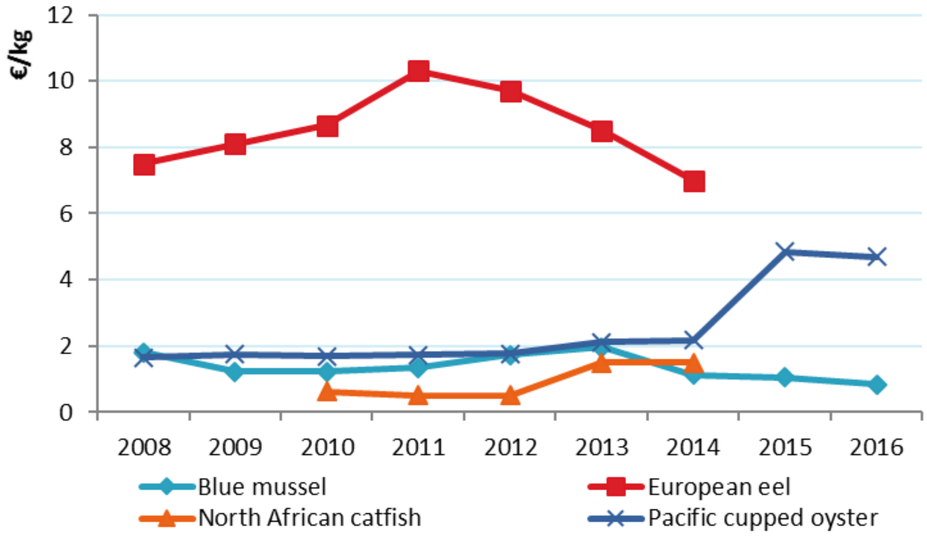


Figure 4.19.5 Average prices for the main species produced in the Netherlands: 2008-2016.
Source: EU Member States DCF data submission

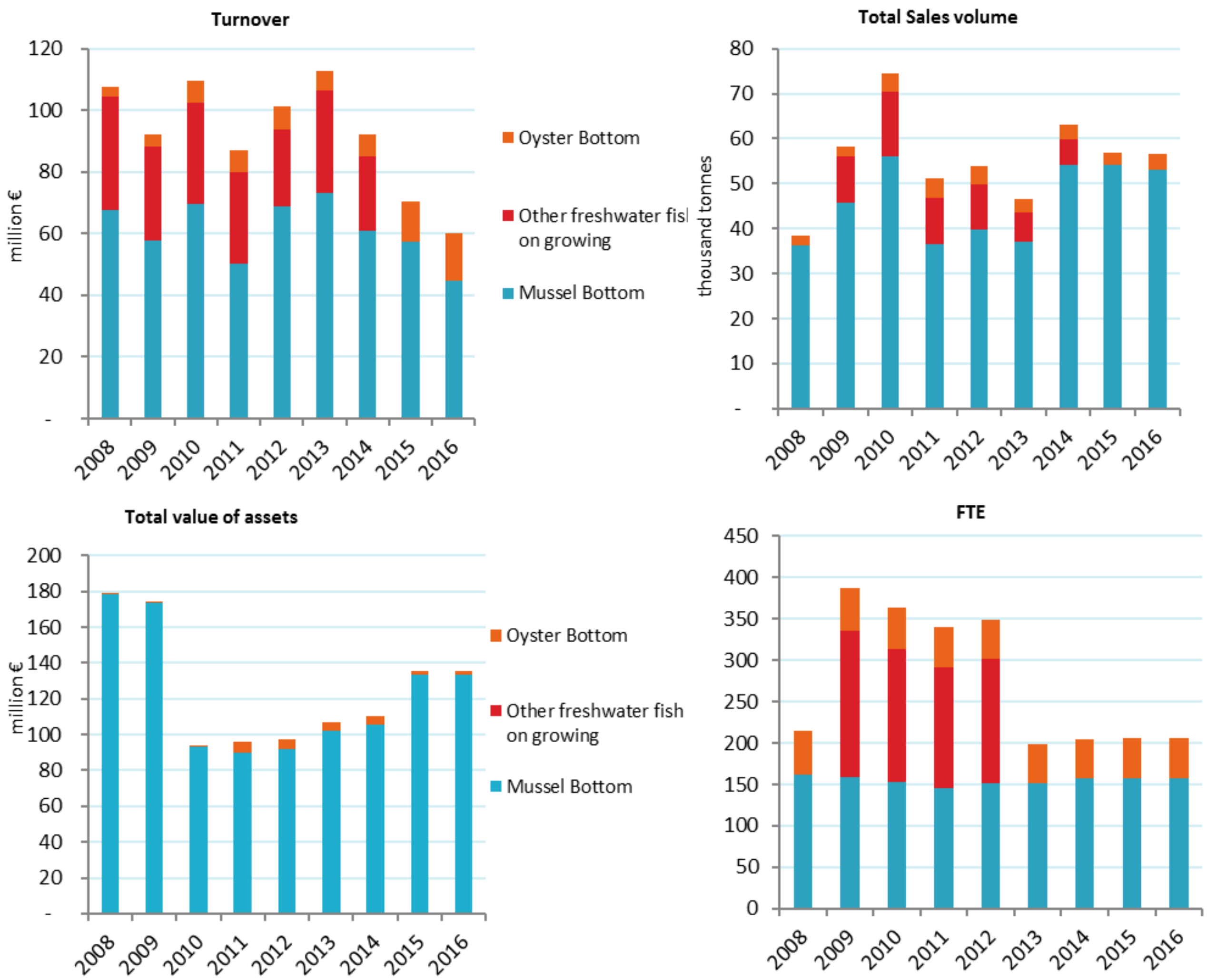


Figure 4.19.6 Structural development Dutch aquaculture sector: 2008-2016
Source: EU Member States DCF data submission

Segment 2: Oysters on bottom culture

The oyster industry is different from the mussel industry. The scale of production is lower, companies are smaller and the majority of the entrepreneurs combine the culture of oysters with other activities. The capital invested in the vessels is much lower (average age around 70 years) than for the mussel sector, resulting in a higher return on investment and capital productivity, but labour productivity is much lower than in the mussel sector. Total sales volume in 2016 was 3.3 thousand tonnes, an increase of 22% compared with 2015. Revenues are based on flat values and amounted €16.4 million in 2016 (€13.9 million in 2015).

Segment 3: Freshwater aquaculture on land

The third sector of aquaculture in the Netherlands consists of finfish aquaculture. European eel and North African catfish are the two most important species.

Unfortunately, no figures are available from the year 2015 until now.

In Table 4.19.14, the economic performance of the Dutch shellfish segments is shown. From the table it can be seen that the mussel sector performed slightly lower in 2016 vs 2015 and that the oyster sector performed significantly better in 2016 compared to the year 2015.

Table 4.19.14 Economic performance of main Dutch aquaculture segments: 2008-2016 (in million €).

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	% of total income	Change 2016/15	Development 2016/(2008-15)
Mussel Bottom												
Total income	73.9	60.9	73.8	52.0	70.7	75.7	63.4	60.5	47.3	100%	-22%	-29%
Gross Value Added	50.8	33.0	46.8	29.7	38.5	47.7	36.5	31.5	21.7	46%	-31%	-45%
Operating cash flow	44.9	26.0	39.2	22.0	30.4	39.1	27.3	21.3	11.4	24%	-46%	-63%
Earning before interest and tax	41.9	16.3	33.1	19.3	28.6	37.4	25.2	18.8	8.9	19%	-53%	-68%
Net profit	38.5	12.9	29.3	15.6	25.3	34.3	22.3	15.7	5.8	12%	-63%	-76%
Total sales volume (thousand tonnes)	36.2	45.6	56.2	36.6	39.7	37.1	54.1	54.1	53.2		-2%	18%
Oyster Bottom												
Total income	4.1	4.0	7.1	7.3	7.6	6.3	7.3	13.9	16.4	100%	18%	128%
Gross Value Added	2.8	2.8	5.6	5.9	6.3	5.0	5.7	11.6	13.8	84%	19%	141%
Operating cash flow	1.7	2.3	4.7	4.3	4.7	3.8	4.4	8.6	10.2	62%	19%	138%
Earning before interest and tax	1.5	2.1	4.6	4.0	4.5	3.3	4.1	8.4	10.0	61%	19%	147%
Net profit	1.4	2.1	4.6	3.9	4.5	3.3	4.1	8.3	9.9	61%	19%	148%
Total sales volume (thousand tonnes)	2.1	2.3	4.2	4.2	4.2	3.0	3.3	2.7	3.3		22%	2%

Source: EU Member States DCF data submission

In Figure 4.3.7, the economic indicators for the shellfish segments are presented. The mussel sector shows a lesser performance in 2016, whereas the oyster kept stable. The oyster sector might change to growing the oysters on tables, which might lead to smaller margins, due to higher assets value and higher labour costs.

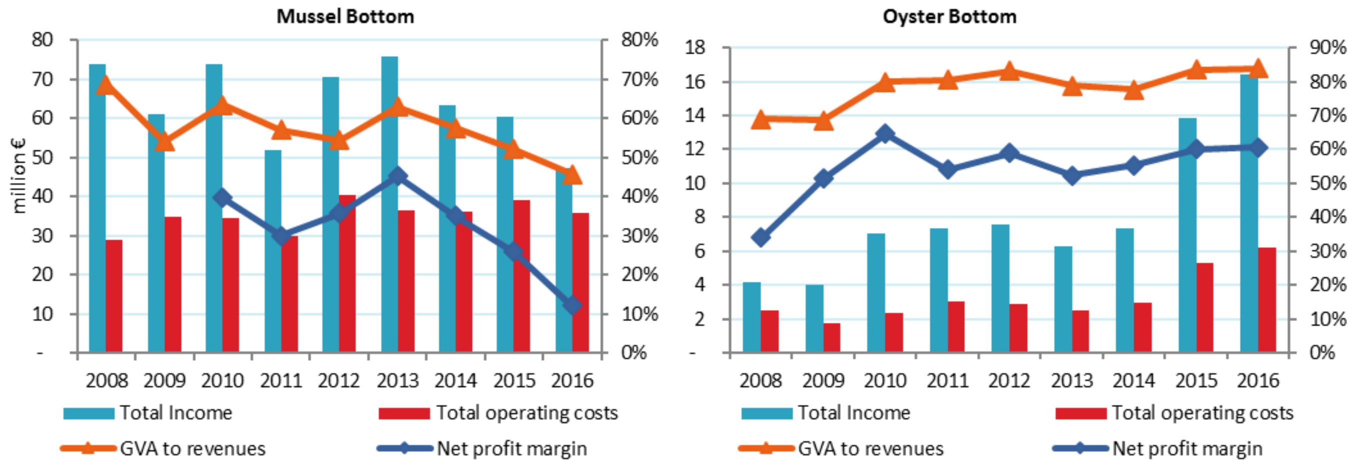


Figure 4.19.7 Economic performance indicators for the mainBulgarian Dutch segments: 2008-2016.
Source: EU Member States DCF data submission

In Figure 4.3.8 the operational cost structures for the two Dutch shellfish segments are presented. No operational costs from 2014 unit now are available for freshwater aquaculture.

Segment 1: mussels on bottom cultures

Most important costs items include other operational costs 41%) wages and salaries (27%) and repair and maintenance (12%). Within other operational costs, rental costs for the area where the mussels are farmed are important, as well as the costs that relate to the mussel seed collectors. In an agreement with the Dutch Ministry and environmental NGOs, the mussel sector started a transition from wild seed fisheries to sustainable alternatives (mussel seed collectors) in 2020. Although the collectors work quite well and guarantee a quite stable mussel seed production, the work requires a lot of labour.

Segment 2: Oysters on bottom culture

Most important costs items for the oyster sector are wages and salaries (55%), repair and maintenance (29%) and energy costs (8%). The variable "other operational costs" also includes the costs of lease of the growing area.

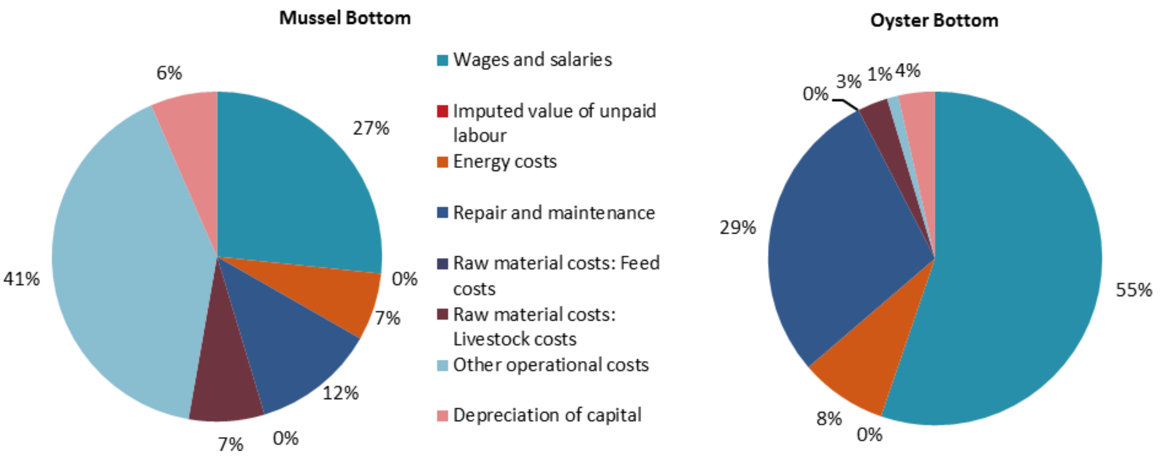


Figure 4.19.8 Cost structure of the main segments in the Netherlands: 2016.
Source: EU Member States DCF data submission

There is almost no trade in mussel seed at all, so the average price per kg mussel seed. The costs that come with the mussel seed collectors are included in "other operational costs".

4.19.5 Trends and triggers

Current production trends and main drivers

The decreased economic performance of the mussel culture sector in 2016 is largely explained by the low prices of blue mussels, caused by a larger import of mussels, and the TTX problem. The mussel sector is in transition towards the use of mussel seed collection technologies, rather than bottom trawling. Growing seed on mussel seed collectors is more expensive than trawling for the seeds, and will have an effect on the economic performance. However, by using mussel seed collectors, the sector is more independent from natural seed fall. The sector is facing competition from foreign competitors, which are often owned by Dutch enterprises. Where in earlier years a small harvest meant higher prices, nowadays mussels are imported from other member states which means that prices will not rise.

The oyster sector has increasing problems with larvae and seed mortality due to the presence of Herpes virus and the Japanese oyster drill in the Dutch waters. To fight the Japanese oyster drill, the “oyster drill trawl” has been invented and there is research being done to grow the oysters off bottom on tables

For the fresh water sector, no data is available.

Market structure

The market structure of the mussel sector changes. For mussel production, the number of producing companies decrease. Smaller family companies are overtaken by (mostly) vertically integrated (family) companies. The market structure of the oyster sector has not witnessed major changes in the last years. For oyster production, the number of companies producing and trading remains stable. The mussel and oyster sector continues to have close contact with research institutes and (local) politics.

For the fresh water sector, no data is available.

Issues of special interest

A part of the total budget of the new Dutch operational program is allocated for aquaculture. The objective for aquaculture is to increase the value of aquaculture production via niche and high-value products. Beside this, the Netherlands will increase environmental and economic sustainability, by creating better cooperation, knowledge sharing and increased technical innovation.

Recently, interest for aquaculture in combination with offshore wind energy has increased. This might be a solution to spatial conflicts in the heavily used North Sea, and it might come with some synergy reducing operating costs.

In the last years, academic and business interest in production of seaweeds has grown. The first commercial seaweed farms were established in 2013 and might prove to be an impulse for the aquaculture sector in the Netherlands. However, economic and ecologic values need to be proven.

Producer organisation ‘PO Mossel’ set up a knowledge/innovation agenda for coming years to improve production efficiency in terms of volume per unit area on current mussel beds. At the moment production efficiency is relatively low and could be improved.

The Dutch oyster association started with experiments for off bottom oyster farming to decrease the oysters’ mortality from the Japanese oyster drill and Herpes virus.

Outlook for 2017 and 2018

The combination of mussel seed collection by bottom trawling and other technologies will improve the seed supply in future. In 2015, 19.6 million kg seed was collected via mussel seed collectors, in 2016 18.1 million kg. However, when we look at the last 10 years, it is a growing trend. The available amounts of mussel seed in the years 2015 and 2016 are the basis for mussel production in 2017 and 2018. Sales volumes may reach over 50 thousand tonnes in these years, although storms that lead to loss of livestock always may lead to loss of production. Family enterprises that are less profitable and solvable may be forced by their banks to sell mussels that are not fully grown, or forced to sell in times when prices are low: that may lead to a lower sales volume as well.

In 2018, some of the area's where mussels are farmed will be relocated to what are believed better locations. That probably will lead to a higher production efficiency.

The profitability of the mussel sector will be affected by the increased supply of mussels from surrounding MS. It is expected that smaller family businesses, which are not vertically integrated, will face problems coming years. It is expected that the larger enterprises will take over the smaller family enterprises that cannot survive.

Projects were started in 2016 to grow oysters off bottom to prevent mortality from the Japanese oyster drill. However, the expected loss to the Japanese oyster drill and the herpes virus may not be that large as in previous years was thought, partly because of the fact that a trawl was invented that trawls and therefore removes the Japanese oyster drills.

For the fresh water sector, no data are available.

4.19.6 Data Coverage and Data Quality

Data quality

The account statistic for 2016 is based on a sample of 18 aquaculture companies (shellfish), which covers 26% of the total population of 70 farms. These 18 companies provide detailed information to Wageningen Economic Research, that is used for extrapolation to the entire sector. Additional aggregate information on sales volume and value of mussels and oysters is available from Statistics Netherlands, the Dutch oyster association and the mussel producer organisation 'PO mossel'.

For the fresh water sector, no data are available for 2015 and 2016. In earlier years, in earlier years, information on the number of freshwater companies, sales volumes and values was retrieved from the Dutch aquaculture association NEVEVI and own databases of Wageningen Economic Research. Additional aggregate information on sales volume of eel was available from Statistics Netherlands.,

Data quality differs considerably for the three sectors. Information on the mussel sector comes from 15 companies (29% of in total 51 companies). A total of 3 oyster companies provide detailed information to LEI Wageningen UR (16% of in total 19 companies). Concerning freshwater aquaculture, no companies provided detailed information (0% of in total 36 companies).

Data availability

Data of land based aquaculture is not collected as planned. Land based aquaculture in the Netherlands is a relatively small (36 farms in 2014), reluctant, fragmented, highly competitive and dynamic. Only information on the number of freshwater companies, production volume and value level could be obtained for this segment. This information was gathered from a desk study and information from the Dutch aquaculture association NEVEVI. Data of the mussel and oyster sector is collected in accordance with the Dutch National Plan. After collecting the information and having it checked by accountants, the companies voluntarily submit data to Wageningen Economic Research. As some companies work with financial years running from July to July, submission of this information can take place late. Once all information is collected, it is processed by Wageningen Economic Research.

Confidentiality

Obviously, the fact that such a low number of companies deliver information is a problem for confidentiality. When collecting data, Wageningen Economic Research explicitly mentions that the information will be treated confidentially. General guidelines that segments should include more than 10 enterprises would be hard to put into practice, given the low number of companies in the oyster segments.

Differences in DCF data compared with other official data sources

When comparing the Dutch data for DCF with the value and production registered by EUROSTAT, the following remarks can be made.

In general, the DCF and EUROSTAT data are generally in line with each other. Differences between DCF and Eurostat could be explained by the extrapolation that affects total production levels.

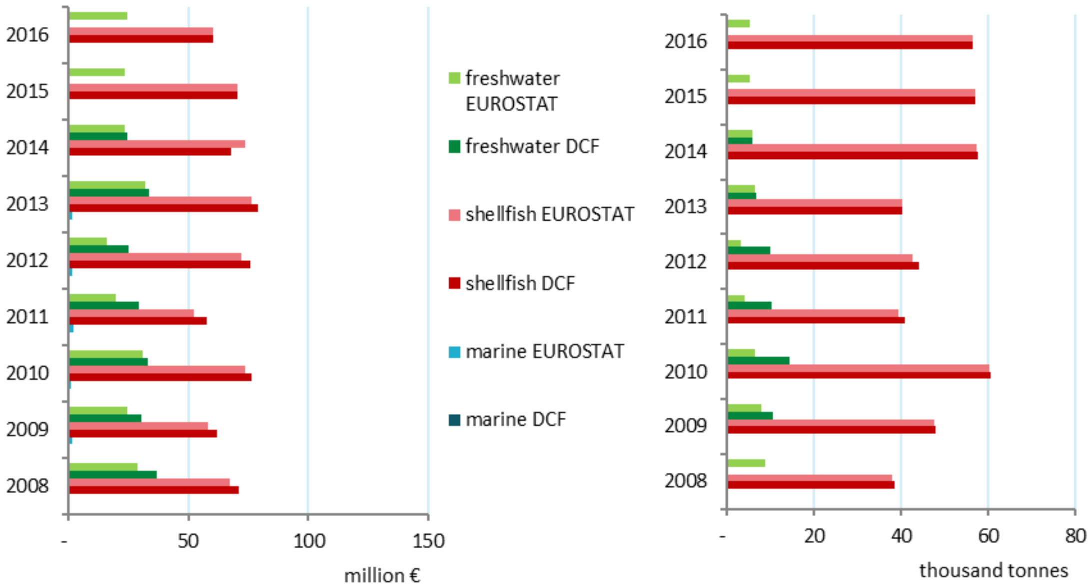


Figure 4.19.9 Comparison of DCF data with EUROSTAT data for the Netherlands: 2008-2016

4.20 Poland

4.20.1 Production and sales

In 2016, the total volume of Polish aquaculture production was 38.3 thousand tonnes (FAO 2018) of which 35.5 thousand tonnes were destined and sold for consumption (Eurostat 2018) corresponding to €109.6 and €91.5 million, respectively. Total sales value and volume increased by 6% compared to 2015. From the average production between 2008 and 2015, the total volume increased by 2%, whereas the total value increased by 21%.

Polish Inland Waters Institute reported that, in 2016 the value of roe intended for consumption amounted to €99.1 million. It is increase by almost 16% compared to 2015 value.

Table 4.20.1 Production and sales for Poland: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 15-16	Develop. 2016/(08-15)
Production weight (thousand tonnes)	***36.8***	***36.5***	***36.5***	***34.2***	***33.2***	***31.3***	***36.3***	***33.6***	***35.5***	***6%***	***2%***
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Freshwater	36.8	36.5	36.5	34.2	33.2	31.3	36.3	33.6	35.5	*6%*	*2%*
Production value (million €)	***73.3***	***76.4***		***101.7***	***105.1***	***75.1***	***88.4***	***86.6***	***91.5***	***6%***	***6%***
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Freshwater	73.3	76.4		101.7	105.1	75.1	88.4	86.6	91.5	*6%*	*6%*
Hatcheries & nurseries (million units)	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0%***	***0%***
Eggs	0	0	0	0	0	0	0	0	0	*0%*	*0%*
Juveniles	0	0	0	0	0	0	0	0	0	*0%*	*0%*

Source: EUROSTAT, 2018

4.20.2 Industry structure and employment

The total number of persons employed[7] in the Polish aquaculture sector was 6 344 and it decreased by 12% compared to 2015. Directly in production there were 5 133 employees (80.9%), of whom 3 349 were permanently employed, while 1 784 were seasonal. Other employees (not working directly in production - among others office workers, warehousemen, fishermen's guards) are 1 211 people. The Polish aquaculture sector is operated by professionally trained personnel. There is a well-developed education system for fisheries and aquaculture.

4.20.3 Structure and performance of aquaculture segments

In Poland, aquaculture production is carried out exclusively with the use of fresh water[8] and included in 2016 the breeding of approximately 30 species of fish intended for both consumption and restocking. Two species of crustaceans are also produced in domestic aquaculture (European and Danube crayfish) intended for consumption and for the recovery of fishing circuits[9].

The biggest sector is the production of carp. In 2016 common carp stood for 49% of the total volume of production and for 43% of the whole total value of aquaculture production. The volume of production of common carp increased to 17.4 thousand tonnes (about 7%) and to the value of €39.6 million (about 10%). Despite the high and relatively stable domestic production of carp, the share of this species in total fish production is decreasing year by year (in 2012 this share was 54.9%, 53.6% in 2013, and 50.6% in 2014). The changing proportions are caused by the increase in the production of other fish species in intensive aquaculture. Carp is produced mainly

[7] Produkcja rybacka prowadzona w stawach rybnych i innych urządzeniach służących do chowu lub hodowli w roku 2016 na podstawie analizy kwestionariuszy RRW 22; Instytut Rybactwa Śródlądowego w Olsztynie; Żabieniec, październik 2017.

[8] In Zachodniopomorskie Voivodeship, one farm using geothermal saline water was launched in 2015.

[9] Produkcja rybacka prowadzona w stawach rybnych i innych urządzeniach służących do chowu lub hodowli w roku 2016 na podstawie analizy kwestionariuszy RRW 22; Instytut Rybactwa Śródlądowego w Olsztynie; Żabieniec, październik 2017.

for the domestic market. Demand is seasonal and stagnating. Most carp is sold in December before Christmas Eve in the form of live fish and fresh whole fish.

Carp farms are widespread all over the country but the largest facilities are located in central and southern Poland where climatic conditions are warmer and thus more profitable. Carp production is carried out in earth ponds. Total earth ponds useable area of production for carp is about 60 thousand ha, which stands for about 79% of total area of earth ponds registered by the Central Office of Cartography and Geodesy.

In 2016, Poland imported about 4.4 thousand tonnes of live and frozen carps valued over €8 million. The largest number of live carps comes to Poland from the Czech Republic (65%) and Hungary (25%) and Lithuania (9%). Poland exported about 660 tonnes valued €1.05 million live, fresh and frozen carps in 2016. Most of the live carp goes to Czech Republic (40%) and Germany (27%). Poland exports fresh and frozen carps mainly to Germany (46%) and Lithuania (30%).

The growth of the carp market in Poland was possible mainly due to promotional campaigns of discount supermarkets offering carp fillets in modern MAP packaging, price war of hypermarket chains offering live carp at very attractive prices for clients, earlier promotion than usual Christmas and wide range of products (slices, fillets, bells, gutted and live fish).

The next sector is harvesting of rainbow trout, which contributed 39% of the total volume of production and 43% of the total value of aquaculture production. Sold production of rainbow trout increased to 13.7 thousand tonnes (about 7%). The total value of sold production was €38.9 million, which corresponds to an increase of 8%.

Trout production is carried out in concrete ponds that are supplied with water from rivers or other running sources with partial recirculation of water. Trout farms are located in the north on the Baltic Sea coast and in southern Poland in the Carpathian foothills in rich terrain with clear, cool waters.

The main factor which stimulates the production of rainbow trout, in addition to domestic demand, is export which in 2016 stood at 7.1 thousand tonnes. More than half of the trout export goes to the German market, mainly smoked (around 87%). In 2016, Poland imported about 13.7 thousand tonnes of live, fresh and frozen trout.

In terms of volume another important species were chars nei (3%) and silver carp (1%). Third main species in terms of value were sturgeons nei (3%) with €2.5 million and brook trout production with the value of €1.7 million.

Many farms produced in polyculture more than one freshwater species, mainly African and European catfishes, grass carp, silver carp, bighead carp, crucian carp, pike, tench and sturgeon. There are few fish farms in Poland producing salmon, sturgeon, tilapia, and barramundi using recirculation system.

Figure 4.20.1 Main species in terms of weight and value in Polish aquaculture production: 2016.

Source: EUROSTAT

Prices for aquaculture species were rather stable during four last years. In 2016, average prices for rainbow trout decreased by 1% to €2.8/kg, also for norther pike by 3% to €4.4/kg. Average prices for grass carp, sturgeons and common carp increased in 2016 about 2-3% compared to 2015.

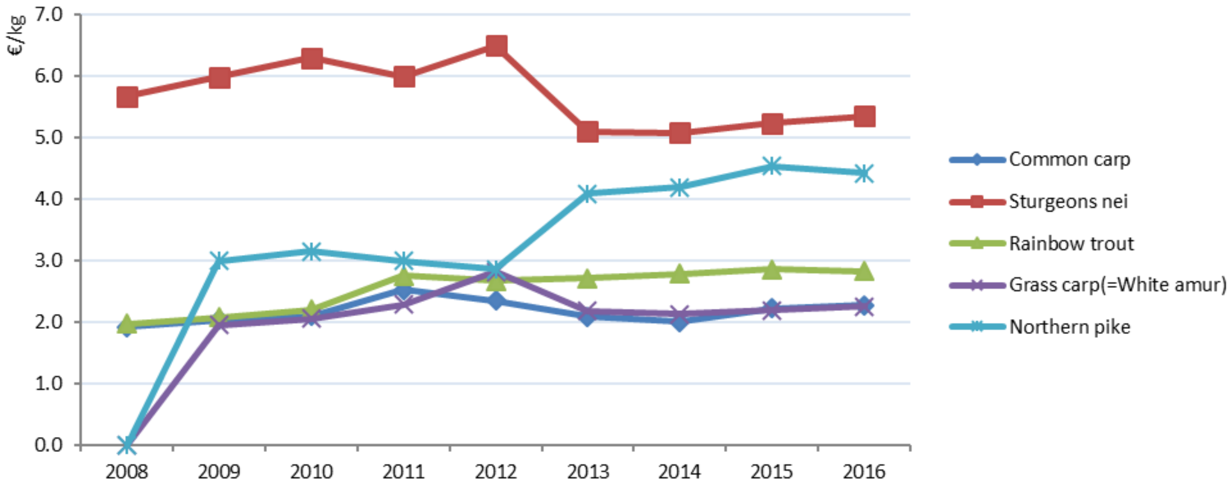


Figure 4.20.2 Average prices for the main species produced in Poland: 2008-2016.
Source: EUROSTAT and FAO

4.20.4 Trends and triggers

In Poland freshwater aquaculture production is dependent on the prevailing meteorological conditions. In the case of carp, too low autumn temperature shortens the feeding period and growth of fish. However, in the case of trout, too high temperature continuing in the period from June to August limits feeding and weight gain of fish. The main limiting factor in achieving maximum potential yields is outbreaks of viral diseases and also pressure of piscivorous animals (cormorants, otters) which are protected.

The outlook for the development of trout production in Poland is optimistic. This is based on the high degree of modernization at existing facilities and the construction of new trout farms, the increasing share of processed trout on the market (smoked trout, vacuum-packed fillets, etc.), the marketing of trout in Poland and growing exports.

An important element of domestic aquaculture, in addition to the production of aquatic organisms for consumption, is the production of stocking and stocking material of many fish species. The increasing demand for new fish development stages and the introduction of new breeding technologies into the practice stimulates the construction of breeding grounds, incubating fish and fish brooders and breeding-nursery hatches, which additionally carry out further hatching of raised hatch to older forms of stocking and stocking material.

A dynamic growth in the production of consumer fish for various species of aquatic organisms by 2020 requires a large supply of good quality stocking material for ponds and other fish farming and breeding equipment. Also, the needs of restocking fisheries are an argument for intensifying the production of young fish development stages.

According to forecasts, in Poland demand for restocking material will be high in the coming years. This is caused, among others the obligation to restock fishing districts in accordance with the standards contained in accepted fishing operations and the need to restock Polish sea areas. Under the Operational Programme "Fisheries and the Sea" 2014-2020 almost €269 million was planned to support aquaculture (priority axis 2 "Environmentally sustainable, resource-efficient, innovative, competitive knowledge-based aquaculture") of which 75% is support from the EMFF. The funds for aquaculture from 2014 to 2020 are more than twice as big as allocation in the previous programming period.

In addition, since 2013, a new segment of aquaculture has been dynamically developing, specializing in the production of fish eggs intended for consumption, including the most valuable caviar of sturgeon fish. The dynamically growing production of sturgeon fish eggs has a significant impact on the sturgeon market, which requires increasing the stock of fish intended for retrieving eggs for caviar. In 2016, the production of eggs for consumption reached a record weight of 18.8 tonnes, of which the most valuable sturgeon caviar accounted for 87.3% of total production[10].

2.1.1 Data coverage and quality

Poland is not obliged to collect aquaculture economic data in accordance with the provisions of Chapter V, point of 5. Commission decision (EU) 2016/1251 of 12 July 2016 (notified under document C(2016) 4329).

[10] Produkcja rybacka prowadzona w stawach rybnych i innych urządzeniach służących do chowu lub hodowli w roku 2016 na podstawie analizy kwestionariuszy RRW 22; Instytut Rybactwa Śródlądowego w Olsztynie; Żabieniec, październik 2017

4.21 Portugal

4.21.1 Production and sales

The production in aquaculture in 2016, was 10 222 tonnes and generated a revenue of €73 718 million. These results translate into an increase of 4% in weight, and 20% in value, compared to 2015, and it corresponded to a major production of clams, the more valued specie.

Production in brackish and marine waters continued to be the most important, corresponding to about 93% of total production by 2016. The production of fish in brackish and marine waters represented 38% of production, of which 87% were sea bream and turbot.

On the other hand, freshwater production increased slightly as a result of a better response to the survey. However, this sector has a little representativeness in Portugal, combine with a low acceptance of this kind of product in the national market and to competitiveness difficulties with other countries in external markets.

Sales have been increasing over the years, in 2016 reached a peak of sales value, namely by the increase of production of the most valued species (carpet shell). Nevertheless, between 2009 and 2016, is to highlight the increase of 68% in weight and more than duplicate (103%) in value in the marine sector.

Table 4.21.1 Production and sales for Portugal: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/ (08-15)
Sales weight (thousand tonnes)	***6.9***	***6.2***	***6.5***	***7.8***	***10.4***	***7.1***	***8.8***	***9.8***	***10.2***	*4%*	*29%*
Marine	3.0	2.4	2.5	3.8	5.6	2.4	4.5	5.0	3.8	*-24%*	*5%*
Shellfish	3.2	3.3	3.3	3.5	4.1	4.0	3.8	4.2	5.7	*36%*	*56%*
Freshwater	0.7	0.5	0.7	0.5	0.7	0.7	0.5	0.6	0.7	*8%*	*10%*
Hatcheries & nurseries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Sales value (million €)	***41.0***	***36.5***	***41.7***	***54.3***	***52.6***	***45.4***	***46.9***	***61.4***	***73.7***	*20%*	*55%*
Marine	16.8	12.5	16.1	23.3	28.9	16.0	24.3	30.0	29.4	*-2%*	*40%*
Shellfish	22.5	22.9	24.1	28.9	21.9	27.5	20.6	29.5	42.5	*44%*	*72%*
Freshwater	1.7	1.2	1.6	2.1	1.7	1.8	2.0	1.9	1.9	*-1%*	*6%*
Hatcheries & nurseries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		*0%*

Source: EU Member States DCF data submission

4.21.2 Industry structure and employment

At the end of 2016, there were 1 402 licensed establishments with sales in aquaculture to freshwaters, brackish and marine waters. This represents more 20 units in relation to 2015. In terms of total area, it is practically the same area than before, with an average size of 3.1 hectares per aquaculture establishment[11].

As regards the type of production facilities, the structure remained the same, about 87.9% for the production of bivalve molluscs in intertidal zones. Tanks and earth ponds for fish production accounted for 9.4% and floating structures (mainly for the production of bivalve molluscs) accounted 2.1% of all licensed establishments[11].

Distribution by gender shows a dominance of the male work force, representing 80% of the total job. The representation of female workers has been increasing constantly until 2013. From 2013 to 2014 there was a decrease of 12% in the number of female workers, but the evolution since 2009 shows an increase of 89% while the number of male employees only increased 5%. In 2016, the total number of people employed in the Portuguese aquaculture sector was 2 650, corresponding to 829 FTEs.

The biggest change observed is in the enterprise’s performance from 2010 to 2011. After 2011, the total number of FTE has been more or less constant, with an increase in 2016. The accommodation of economic and financial restrictions as well as more efficient processes induced

[11] Estatísticas da Pesca 2017. DGRM.

a change of paradigm in employment. The partial time contracts are now, more common in big enterprises than in years before.

Table 4.21.2 Structure of the Portuguese aquaculture sector: 2008-2016

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/ (08-15)
Structure (number)											
Total enterprises	*1,463*	*1,454*	*1,459*	*1,435*	*1,432*	*1,430*	*1,405*	*1,382*	*1,402*	*1%*	*-2%*
<=5 employees	1,446	1,443	1,443	1,423	1,418	1,408	1,381	1,355	1,337	*-1%*	*-5%*
6-10 employees	11	7	9	7	10	14	16	18	55	*206%*	*378%*
>10 employees	6	4	7	5	4	8	8	9	10	*11%*	*57%*
Employment (number)											
Total employees	*2,347*	*2,306*	*2,320*	*2,244*	*2,362*	*2,335*	*2,247*	*2,329*	*2,650*	*14%*	*15%*
Male employees		2,024	1,889	1,773	1,885	1,847	1,816	1,835	2,117	*15%*	*13%*
Female employees		282	430	471	477	488	431	495	534	*8%*	*22%*
FTE		1,227	1,228	574	669	707	697	726	829	*14%*	*0%*
Male FTE		1,085	1,004	492	560	585	588	605	682	*13%*	*-3%*
Female FTE		142	224	82	109	122	108	121	148	*23%*	*14%*
Indicators											
FTE per enterprise		0.8	0.8	0.4	0.5	0.5	0.5	0.5	0.6	*11%*	*1%*
Average wage (thousand €)		7.5	7.2	13.8	13.1	13.8	12.1	13.5	13.7	*2%*	*18%*
Labour productivity (thousand €)		13.3	10.0	65.9	55.1	31.6	39.8	61.5	100.8	*64%*	*155%*

Source: EU Member States DCF data submission

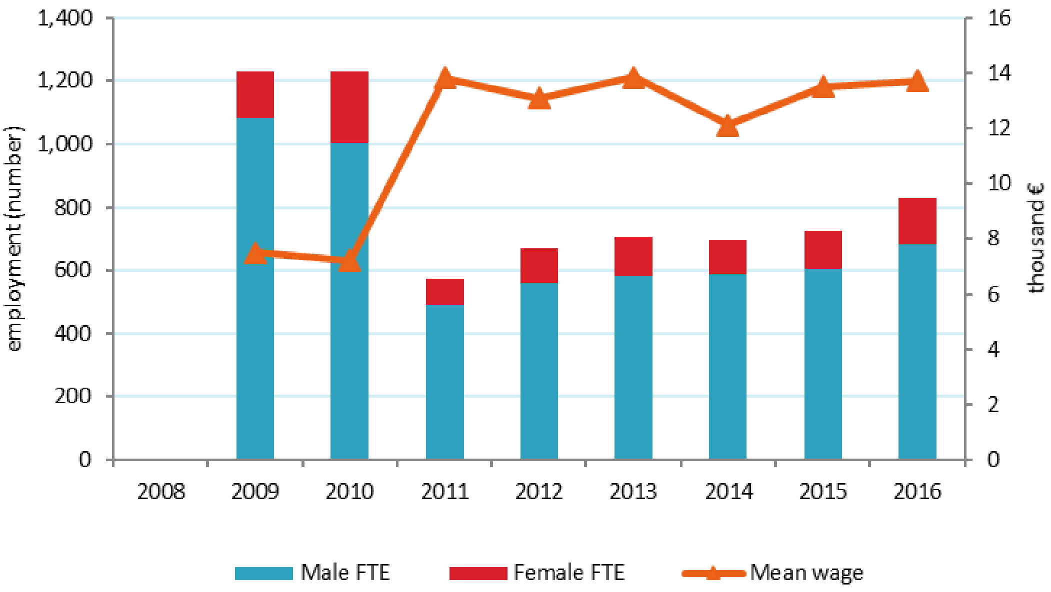


Figure 4.21.1 Employment trends for Portugal: 2008-2016.
Source: EU Member States DCF data submission

From 2015 to 2016, the number of employees increased by 14%. Average FTE per enterprise has stayed the same from 2015 to 2016 but, as seen before, a 30% decrease was observed since 2009. In that way, and as the GVA variation had increased 81%, the labour productivity as registered a significant growth in over this this period.

Total Income is composed by the sum of Turnover, Other Income and Subsidies. The high variation in Total Income is due the fluctuations observed in Other Income, namely in 2012 and 2016. In fact, it was registered an unexpected value of €42 million and €35 million, in 2012 and 2016, respectively, corresponding to just one enterprise. The labour productivity is measured as gross value added per full time employee.

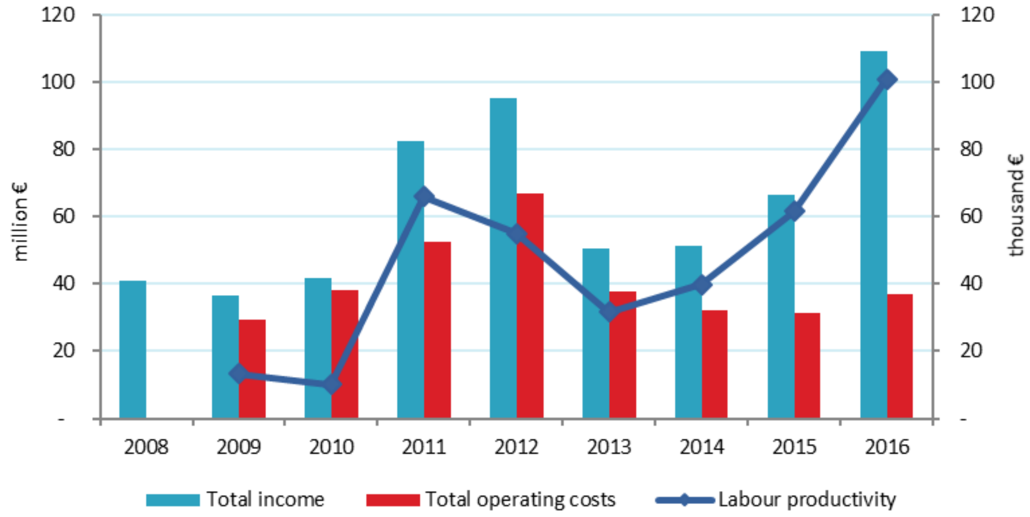


Figure 4.21.2 Income, costs, wages and labour productivity trends for Portugal: 2008-2016.
Source: EU Member States DCF data submission

4.21.3 Economic performance

From 2015 to 2016, total income increased by 65% and the operational cost also increased by 17.6%. The total income is dominated by the turnover from the sale of grooved carpet shell, which contributes 34% of total income.

Concerning the economic performance, it is important to refer the existence of an establishment with an organizational structure different from all the others. Besides that, during an audit to that enterprise, an impairment was recorded to fixed assets. As a result of this operation were registered a very sharp break in the enterprise assets and a considerable increase in the "Other Income". Given the volume of your production and sales, this enterprise has a high representation in the economic performance of the sector. In that way this operation influences the results of all the economic indicators established for the national aquaculture sector.

From 2015 to 2016 all the expenditures have increased, but the most increased is for the other operational costs (119%) and depreciation capital.

The expenses for raw material representing 46% of total costs (of which 63% are feed costs and 37% are livestock costs) and wages and salaries costs (26%) are the other variables more relevant of total operating costs in 2016.

The total expenditures are 34% of the total income.

The gross value added for the whole sector as increased 87% from 2015 to 2016 as a result of the considerable "Other Income" increase.

Also, as a result of accounting operations at the enterprise level, the sector has registered an improvement in the last year, with 145% and 196% increase in EBIT and net profit. The total value of assets decreased 54% and debts increased 18% respectively. The net investment increased 35%, from 2015 to 2016.

Table 4.21.3 Economic performance of the Portuguese aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	*% of total income*	Change 2016-15	Development 2016/(2008-15)
Income (million €)												
Turnover	41.0	36.5	41.7	54.3	52.6	45.4	46.9	61.4	73.7	*68%*	*20%*	*55%*
Other income	0.0	0.0	0.0	28.1	42.4	5.1	4.5	4.9	35.4	*32%*	*625%*	*234%*
Subsidies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*	*0%*
Total income	*41.0*	*36.5*	*41.7*	*82.4*	*95.0*	*50.5*	*51.4*	*66.3*	*109.2*	*100%*	*65%*	*88%*
Expenditures (million €)												
Wages and salaries		7.0	7.1	7.1	7.8	8.8	7.5	8.6	9.7	*9%*	*12%*	*26%*
Imputed value of unpaid labour		2.2	1.8	0.9	1.0	1.0	1.0	1.2	1.7	*2%*	*44%*	*34%*
Energy costs	2.0	3.4	2.2	3.8	4.3	3.3	3.5	3.5	3.7	*3%*	*4%*	*13%*
Repair and maintenance		3.1	5.4	1.3	1.3	1.8	1.2	1.9	2.0	*2%*	*7%*	*-10%*
Raw material: Feed costs	6.5	6.6	7.1	10.5	11.3	9.9	10.4	9.9	10.5	*10%*	*7%*	*17%*
Raw material: Livestock costs	0.0	6.0	12.2	14.9	11.8	11.3	6.9	4.9	6.3	*6%*	*27%*	*-26%*
Other operational costs	12.2	1.0	2.6	14.1	29.4	1.9	1.7	1.4	3.0	*3%*	*119%*	*-62%*
Total operating costs	*20.7*	*29.5*	*38.3*	*52.6*	*66.9*	*37.9*	*32.1*	*31.4*	*36.9*	*34%*	*18%*	*-5%*
Capital Costs (million €)												
Depreciation of capital		0.4	5.1	9.8	10.9	14.0	12.1	12.0	16.3	*15%*	*36%*	*77%*
Financial costs, net		0.1	0.2	5.1	5.4	7.4	5.7	5.8	5.3	*5%*	*-7%*	*26%*
Extraordinary costs, net		0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*	*-100%*
Capital Value (million €)												
Total value of assets		188.3	223.8	245.9	246.3	259.5	247.1	200.4	92.9	*85%*	*-54%*	*-60%*
Net Investments		172.1	179.1	3.2	9.7	21.8	16.5	22.3	30.2	*28%*	*35%*	*-50%*
Debt		79.9	121.0	7.0	14.9	15.4	3.2	18.1	21.4	*20%*	*18%*	*-42%*
Input & Production (thousand tonnes)												
Raw material: Feed	8.2	7.6	7.3	9.8	9.8	8.0	8.2	8.4	8.8		*5%*	*5%*
Raw material: Livestock	0.1	0.2	0.5	0.6	0.1	0.1	0.1	0.1	0.1		*48%*	*-66%*
Performance Indicators (million €)												
Gross Value Added		16.3	12.3	37.8	36.8	22.3	27.7	44.6	83.6	*77%*	*87%*	*196%*
Operating cash flow		7.1	3.4	29.9	28.1	12.6	19.3	34.8	72.2	*66%*	*107%*	*274%*
Earning before interest and tax		6.6	-1.6	20.1	17.2	-1.5	7.2	22.9	55.9	*51%*	*145%*	*453%*
Net profit		6.5	-1.8	14.9	11.8	-8.8	1.4	17.1	50.6	*46%*	*196%*	*762%*
Capital productivity (%)		8.6	5.5	15.4	15.0	8.6	11.2	22.3	90.0		*304%*	*628%*
Return on Investment (%)		3.5	-0.7	8.2	7.0	-0.6	2.9	11.4	60.2		*428%*	*1232%*
Future Expectation Indicator (%)		91.2	77.8	-2.7	-0.5	3.0	1.8	5.1	14.9		*191%*	*-40%*

Source: EU Member States DCF data submission

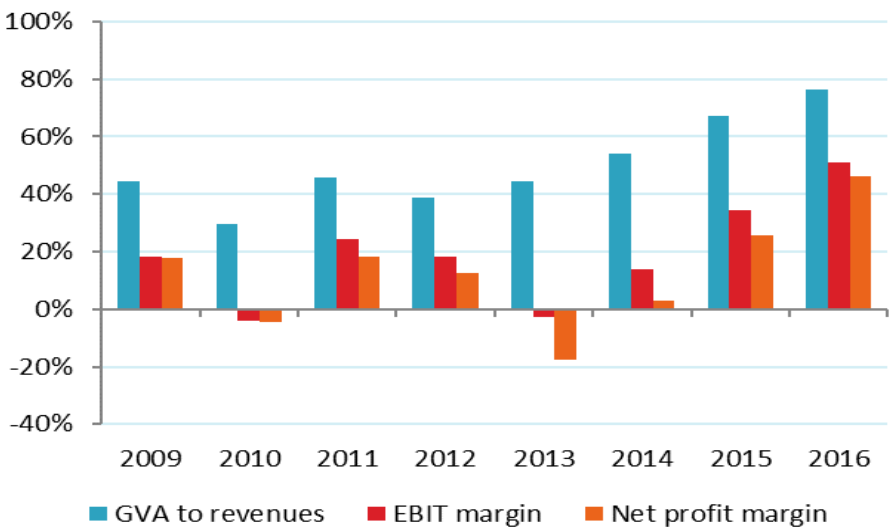


Figure 4.21.3 Economic performance for Portugal: 2008-2016
Source: EU Member States DCF data submission

4.21.4 Main species produced and economic performance by segment

In Portugal, the aquaculture production based on bottom culture (grooved carpet shell) is mainly confined to estuaries and coastal lagoons. For other marine fish, as turbot and sole, is mainly located in the central region of Portugal. Off bottom oyster culture, also appears in estuaries, coastal lagoons and in the sea. Mussel in long line appears in south region of the mainland in open sea. The marine productions of sea bass and sea bream in earth ponds and cages are located both near the coast and in open sea in the Portuguese mainland coast and in the Autonomous Region of Madeira.

The production in Portugal is dominated by four main segments:

Segment 1: Clam on bottom

The most important segment (in terms of production weight and sales value), is the clam on bottom farms producing Grooved Carpet Shell, in small areas of land in intertidal zone, usually with less than 1 hectare. In 2016, there were 1.254 farms. The production volume was 3.618 tonnes with a value of €34.5 million, represents 47% of the total volume and 35% of the total value of production.

Segment 2: Other marine fish on growing

The second most important segment is the marine production of other marine fish on growing (turbot and sole). The production volume was 2.227 tonnes with a corresponding value of €17.9 million, represents 22% of the volume and 24% of the value total production. The production techniques used are tanks and recirculation systems (RAS).

Segment 3: Sea bass and Sea bream on growing

The main species produced in this segment are Sea bass and Sea bream in ponds and cages, merge the segments 3.2 and 3.4. In 2016, there were 28 farms in this segment. The production techniques are semi-intensive and intensive in open systems. The production volume was 1.612 tonnes with a corresponding value of €11.4 million. The segment covers 16% in volume and value of total Portuguese production.

Segment 4: Oyster off bottom

The fourth segment is the oyster off bottom culture in intertidal zones, usually using bags and tables and in the sea using Chinese lanterns on long lines, with 10% in weight and 4% in value

In 2016, the segment has 91 farms, and the production was 1.140 tonnes with a corresponding value of €6.2 million. The segment has increased in last year's, and actually covers 101 of the volume and 8% of the value of total Portuguese production.

Exports represent 26% of total sales production. Exports of aquaculture products consist mainly in turbot sales (90%) and in sole sales (7%)[12].

The average price of turbot has been increased since 2014 mainly from 2015 to 2016, essentially due to the decreased in the production over the last years. The sea bass and sea bream prices have slightly increased in the last year, 9% and 4% respectively. For the rainbow trout the prices have also increased in 2016, recording 13% variation. Concerning the average prices for the oysters group since 2014 it is verified that this value has been increasing, registering a variation of 26%.

The average price of clam presents variations, due to greater or lesser suffering of this product in the market. This type of extensive production depends on the availability of seeds on the natural

[12] Estatísticas da Pesca, 2017. DGRM.

environment as well as the environmental conditions. The emergence of diseases and parasites also influence the extensive productions.

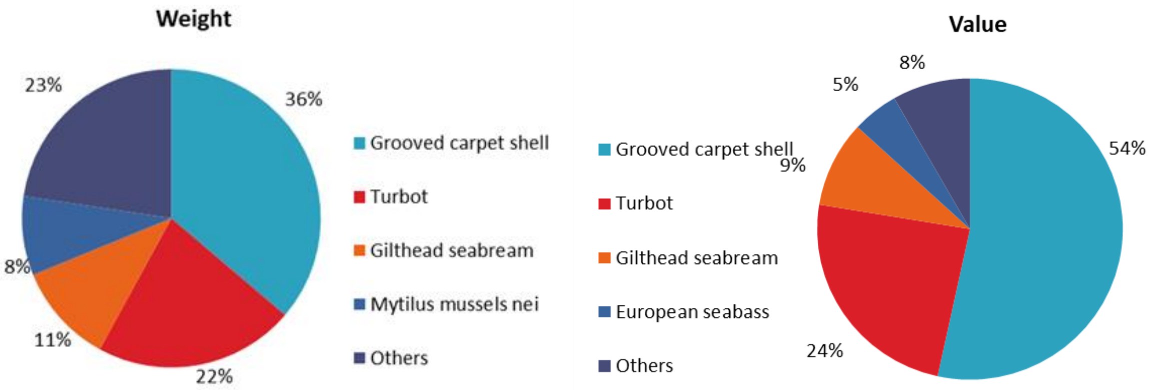


Figure 4.21.4 Main species in terms of weight and value in Portugal production: 2016.
Source: EU Member States DCF data submission

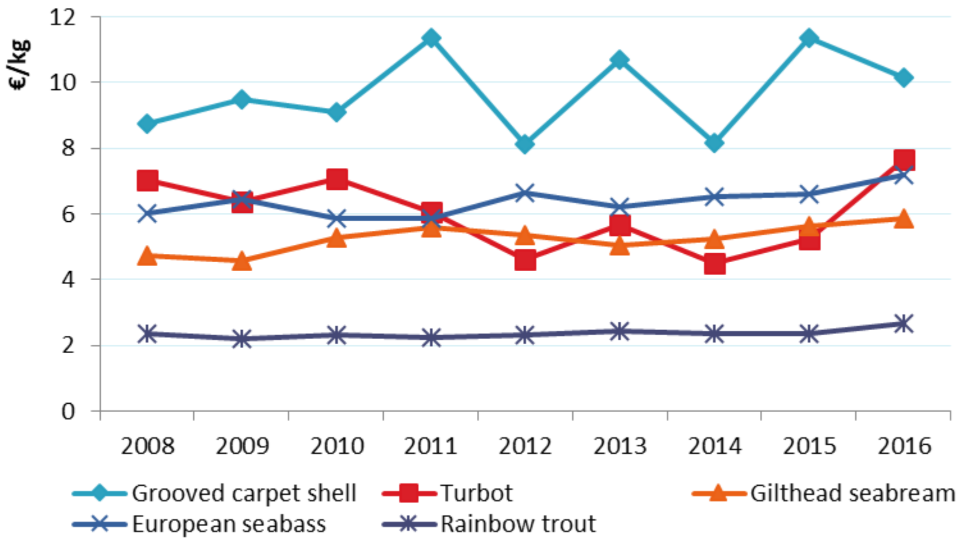


Figure 4.21.5 Average prices for the main species produced in Portugal: 2008-2016.
Source: EU Member States DCF data submission

From Figure 4.3.6 it can be seen that, from 2013 to 2016, the turnover from the Portuguese aquaculture sector had been increasing, along with the sales volume. The total value of assets has decreased, but the total number of FTE has increased.

The economic performance of the main four Portuguese segments is shown in Table 4.3.4 and Figure 4.3.7. From the table it can be seen that in 2016 the gross value added is positive for the four segments but with very low level on the Sea bass & Sea bream and Trout. Net profit and EBIT are negative for other marine fish on growing, from 2008 to 2014 but are positive in 2016 as a result of accounting operations. Sea bass and Sea bream segment have registered better EBIT and net profit in 2015 but those indicators have decreased again in 2016. Trout segment has negative values for EBIT and net profit in almost every year.

The cost structure of the four main Portuguese segments are presented In Figure 4.3.8.

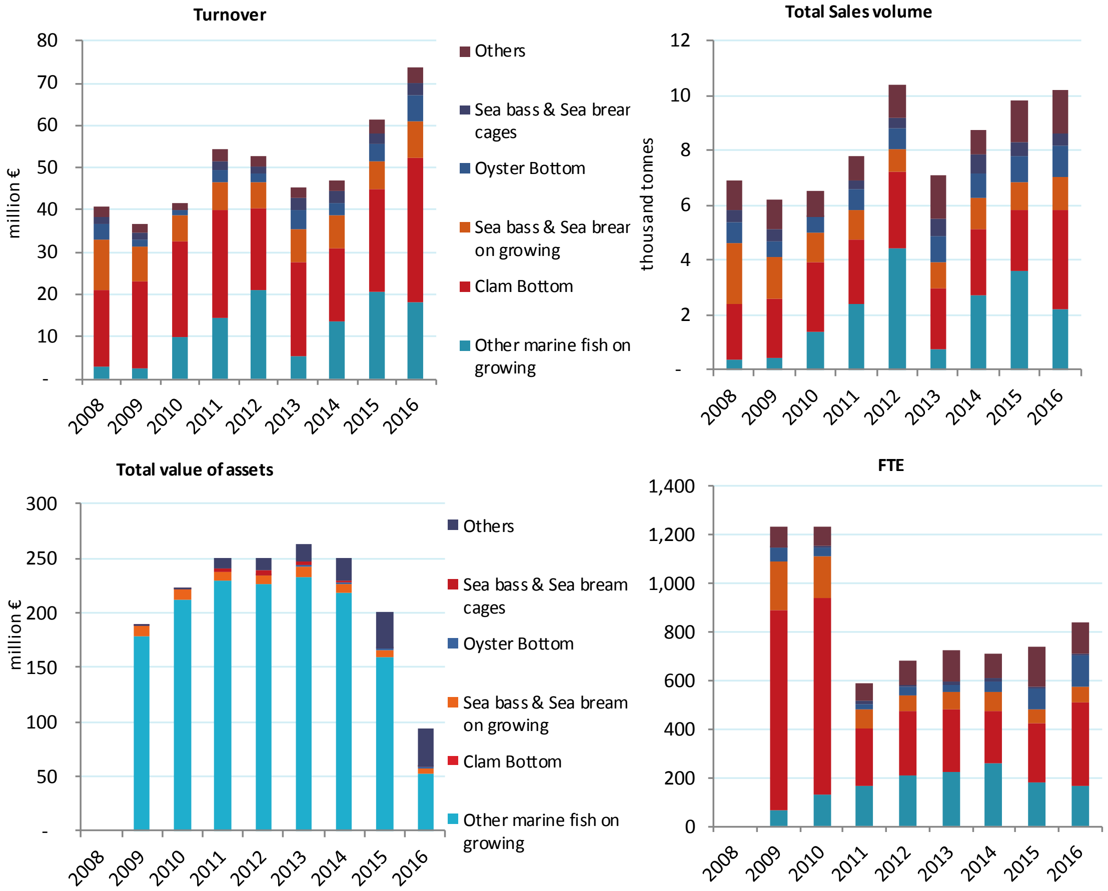


Figure 4.21.6 Structural development of the Portuguese aquaculture sector: 2008-2016.
Source: EU Member States DCF data submission

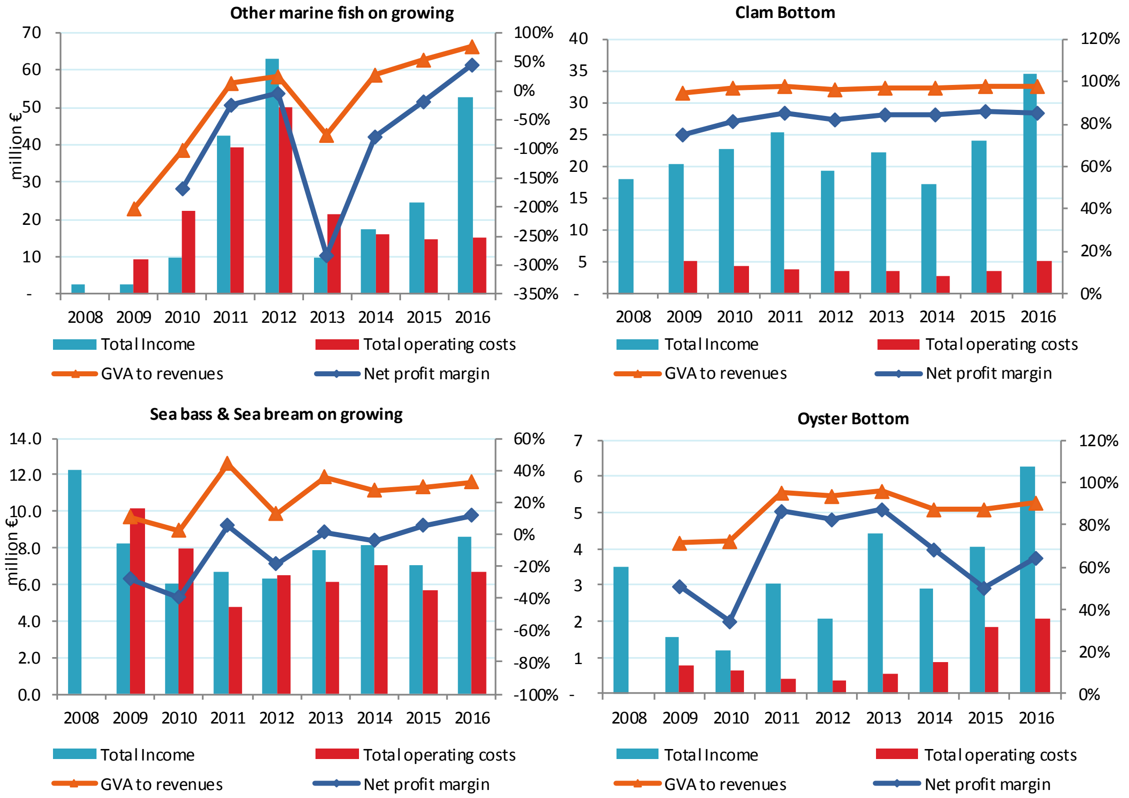


Figure 4.21.7 Economic performance indicators for the main Portuguese segments: 2008-2016.
Source: EU Member States DCF data submission

Table 4.21.4 Economic performance of main Portuguese aquaculture segments: 2008-2016 (in million €).

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	% of total income	Change 2016/15	Development 2016/(2008-15)
Other marine fish on growing												
Total income	2.8	2.6	10.0	42.4	62.9	9.9	17.5	24.7	52.7	100%	113%	144%
Gross Value Added		-5.3	-10.2	5.7	16.3	-7.5	4.8	13.6	40.5	77%	198%	1532%
Operating cash flow		-6.7	-12.3	3.1	12.7	-11.3	1.4	10.3	37.4	71%	264%	9493%
Earning before interest and tax		-6.7	-16.7	-4.8	3.7	-20.7	-7.9	1.0	29.3	56%	2923%	493%
Net profit		-6.7	-16.8	-9.8	-1.6	-27.9	-13.5	-4.6	24.2	46%	630%	310%
Total sales volume (thousand tonnes)	0.3	0.4	1.4	2.4	4.4	0.8	2.7	3.6	2.2		-38%	11%
Clam Bottom												
Total income	18.1	20.4	22.7	25.3	19.3	22.2	17.3	24.2	34.5	100%	43%	63%
Gross Value Added		19.3	22.0	24.6	18.6	21.6	16.7	23.6	33.7	98%	43%	61%
Operating cash flow		15.3	18.4	21.5	15.8	18.8	14.5	20.7	29.3	85%	41%	64%
Earning before interest and tax		15.3	18.4	21.5	15.8	18.8	14.5	20.7	29.3	85%	41%	64%
Net profit		15.3	18.4	21.5	15.8	18.8	14.5	20.7	29.3	85%	41%	64%
Total sales volume (thousand tonnes)	2.1	2.2	2.5	2.4	2.9	2.2	2.4	2.3	3.6		61%	54%
Oyster Bottom												
Total income	3.5	1.6	1.2	3.0	2.1	4.4	2.9	4.1	6.3	100%	55%	121%
Gross Value Added		1.1	0.9	2.9	2.0	4.3	2.5	3.5	5.7	91%	62%	133%
Operating cash flow		0.8	0.5	2.6	1.7	3.9	2.0	2.2	4.2	67%	89%	114%
Earning before interest and tax		0.8	0.4	2.6	1.7	3.9	2.0	2.1	4.1	65%	101%	114%
Net profit		0.8	0.4	2.6	1.7	3.9	2.0	2.0	4.1	65%	102%	113%
Total sales volume (thousand tonnes)	0.8	0.6	0.6	0.8	0.7	0.9	0.9	1.0	1.1		14%	46%
Sea bass & Sea bream on growing												
Total income	12.3	8.3	6.1	6.7	6.3	7.9	8.2	7.1	8.6	100%	22%	10%
Gross Value Added		0.8	0.1	2.9	0.8	2.8	2.2	2.1	2.8	33%	35%	69%
Operating cash flow		-1.9	-1.9	1.9	-0.2	1.7	1.1	1.4	2.0	23%	42%	542%
Earning before interest and tax		-2.2	-2.3	0.4	-1.1	0.2	-0.2	0.4	1.0	12%	136%	246%
Net profit		-2.3	-2.4	0.4	-1.2	0.1	-0.3	0.3	1.0	12%	187%	228%
Total sales volume (thousand tonnes)	2.2	1.5	1.1	1.0	0.8	1.0	1.1	1.0	1.2		21%	-2%
Sea bass & Sea bream cages												
Total income	1.7	1.6	0.0	2.2	1.9	3.0	2.8	2.8	3.4	53%	19%	67%
Gross Value Added		-0.1	-0.7	0.5	-1.1	0.2	0.7	0.7	0.0	-1%	-105%	-297%
Operating cash flow		-0.1	-0.8	0.3	-1.3	0.0	0.5	0.6	-0.2	-2%	-126%	-18%
Earning before interest and tax				-0.1	-1.5	-0.2	0.4	0.6	-0.2	-3%	-136%	-18%
Net profit				-0.1	-1.6	-0.2	0.4	0.5	-0.2	-4%	-143%	-12%
Total sales volume (thousand tonnes)	0.5	0.4	0.0	0.3	0.4	0.7	0.7	0.5	0.4		-9%	-3%
Trout on growing												
Total income	1.7	1.2	1.6	2.1	2.0	1.9	2.1	2.0	1.9	21%	-6%	3%
Gross Value Added		-0.1	0.4	0.7	0.3	0.2	0.5	0.4	0.4	4%	-9%	-1%
Operating cash flow		-0.3	-0.2	0.3	-0.3	-0.2	0.1	-0.1	-0.1	-1%	-7%	27%
Earning before interest and tax			-0.2	0.1	-0.5	-0.4	0.0	-0.2	-0.2	-2%	-3%	-2%
Net profit			-0.2	0.1	-0.5	-0.4	0.0	-0.2	-0.2	-2%	-3%	12%
Total sales volume (thousand tonnes)	0.7	0.5	0.7	0.5	0.7	0.7	0.5	0.6	0.7		8%	10%

Source: EU Member States DCF data submission

Segment 1: Clam bottom culture

Is the most relevant segment, with 1.254 farms and a turnover of about €34.5 million. Enterprises are mostly small familiar units managed by the owner and their relatives. Bottom culture has a very low level of investments and operational costs are mostly wages and salaries.

Segment 2: Other marine fish on growing

The second most important segment is the marine production of other marine fish on growing (turbot and sole). The production volume was 2 227 tonnes with a corresponding value of €17.9 million, represents 22% of the volume and 24% of the value total production. The production techniques used are tanks and recirculation systems (RAS).

In this segment, one big enterprise with a greater investment unbalanced the cost structure, and the depreciation of capital has become the second most significant cost.

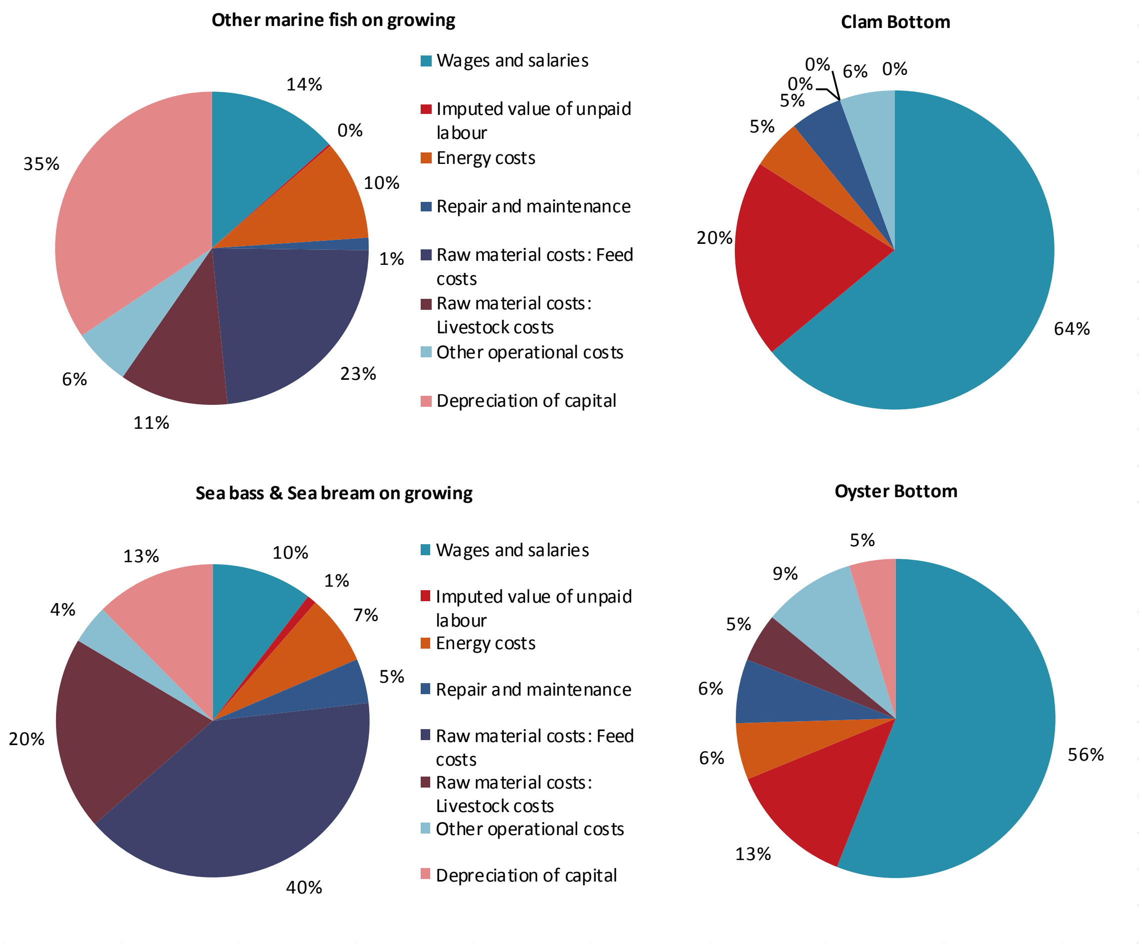


Figure 4.21.8 Cost structure of the main segments in Portugal: 2016.
Source: EU Member States DCF data submission

Segment 3: Sea-bass and Sea-bream on growing

In 2016, there were 28 farms in this segment. The production techniques are semi-intensive and intensive in open systems. The production volume was 1 612 tonnes with a corresponding value of €11.4 million.

It is mostly characterized by traditional production using earth ponds with high maintenance costs and low production densities. The welfare of fish and the environment are taken in high regard and the final product is of high quality. The cages are also included in this segment, characterised by high densities of fish and high livestock and feed costs. In 2016, the depreciation of capital and livestock costs have been higher than the maintenance ones.

The main species produced in this segment are Sea bass and Sea bream in ponds and cages, merge the segments 3.2 and 3.4.

Segment 4: Oyster off bottom

Composed by 91 enterprises, that produce 1 140 tonnes with a corresponding turnover of €6.2 million. The enterprises are mostly small familiar units run by the owner and its relatives. Is this off bottom culture use tables and bags has a very low level of investments and operational costs are mostly wages and salaries. The use of long lines in open sea entails high investments, other operational costs and wages and salaries.

This segment includes mixed type establishments (extensive and semi-intensive system). In this segment, in some years, it may be occasionally happened some feed costs related to the fish production. The tendency is to these establishments turn in bivalve's monocultures.

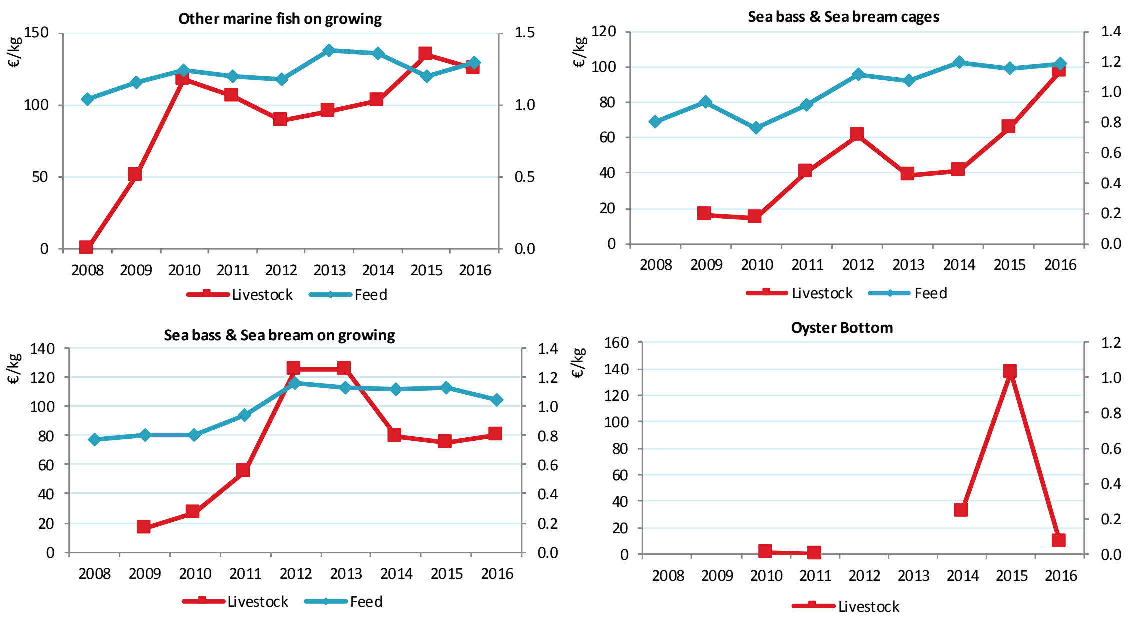


Figure 4.21.9 Feed and livestock prices for the main Portuguese segments: 2008-2016.
Source: EU Member States DCF data submission

4.21.5 Trends and triggers

Current production trends and main drivers

The increase in production in 2016 was mainly because of the production of grooved carpet shell and sea bream and sea bass. Production is expected to grow in the next few years because new projects are under development. These new enterprises will produce mussels, oysters and sole.

Portuguese aquaculture is largely confined to open sea, estuary zones and coastal lagoons. Almost 90% of aquaculture facilities are located in public domain areas, based on 10 to 25-year license, renewable for single time by a same period.

Since 2017, in the procedure of Blue Licensing the maximum period of the licence is 25 years, and be renewed until the maximum period of 50 years.

The enterprises are characterized by a great deal of extensive farming, largely family-based, that don't have an organized system of accountability.

The subsectors in the Portuguese aquaculture are related to the following production systems:

Extensive: The extensive production develops in areas between tides, called intertidal zones, with the cultivation of bivalve molluscs such as clams and oysters. These production units are included in segments 8.3 and 9.3. Most of the units are in the Algarve and Centre regions.

Semi-intensive: Included in segment 6.2, the earth ponds are the main production system for sea-bass and sea-bream in Portugal. Different farms use various levels of stocking densities and pond sizes, but in general these are semi-intensive systems covering large areas with ponds ranging from one to several hectares and production levels from 0.5 to 6 Kg/m3 (mostly around 2 kg/m3) at the end of the production cycle. Although sea-bass and sea-bream are traditionally the target species produced in such ponds, there is commonly natural stocking from wild larvae of other fish species, including Senegalese sole. Previous attempts at on growing sole in ponds in a polyculture regime with sea-bass and sea-bream shows promising growth rates. Species in polyculture regime from different trophic levels have also been considered an efficient and environmentally sound strategy to minimize the impacts of aquaculture systems, because an important fraction of dissolved nutrients and organic matter is recycled within the pond. The difficulties faced by this type of aquaculture are largely related to its high production costs (mainly high labour costs and high land costs) that compromise its economic sustainability due to the low productivity of these systems. There is currently a trend of reconverting the culture practiced on the earth pounds from a fish culture to a mollusc culture, with the consequent decrease in the volume of sea-bass and sea-bream produced.

Intensive: Corresponding to segments 3.2 and 3.4, the intensive production in Portugal refers to the cultivation of turbot and sole. Since 2012 some new developments happened with the production of sole in recirculation systems and in intensive regime as well as the installation of a hatchery of sole. Production costs are high, but the selling price per kg compensates.

Investments in aquaculture are based on spatial planning, seeking not only to minimize possible conflicts with other users with an appetite for the same locations, but also compatible with other uses of the same space, in particular those involved in the conservation of ecosystems, with a view to the sustainable development of aquaculture practices. They will privilege environmental standards in the implementation of the physical structures, but, mainly, in the use of aquaculture production methods compatible with the protection and improvement of the environment. Investments to introduce improvements in management practices of production and marketing, including through the intensification of new information and communication technologies are also encouraged. Structural modernisation is also being promoted within the current fisheries management plan. These objectives are consistent with those established by the EU in the Common Fisheries Policy, and particularly the 2002 Strategy for the Sustainable Development of European Aquaculture, which promotes environmental, economic and social sustainability.

The intervention of the Fund European Maritime Affairs and Fisheries (EMFF), is very important for the investment, innovation and use of new technologies as well as the presentation of new products for new markets.

Production is expected to increase due to new production units, and the possible of investments supported by the EMFF, namely new offshore units for mussels, a new production unit for sole and the increase in production of turbot. The expected production of mussels may in the future introduce a new segment.

Strategic plan for Portuguese Aquaculture 2014-2020 The strategic Plan for Portuguese aquaculture 2014-2020 (PEAP2014) aims to "increase and diversify the supply of products of national aquaculture, based on the principles of Sustainability, quality and food safety, to meet consumer needs and contribute to local development and the promotion of employment

It adopts as guiding principles the sustainable Exploitation of resources, institutional involvement, enhanced quality and food security, and the maintenance and development of employment and quality of life. It intends with an articulated and integrated approach to find solutions that allow to overcome the main constraints of the national sector, meeting what is advocated with the new financial instrument for the Common Fisheries Policy (CFP), the fund European Maritime Affairs and Fisheries (EMFF).

Most of the action of the Operational Program (OP) 2014-2020 are financed by the EMFF, the MAR2020 programme, includes relevant instruments in terms of strengthening the competitiveness of aquaculture regulated all support measures relating to the sustainable development of aquaculture. It is expected that by the end of 2023 global aquaculture production reaches the 25 000 tonnes[13].

Market structure

The Portuguese aquaculture is mostly based on bottom culture units, over 1300 establishments, with strictly family labour. With the definition of new aquaculture sites in open sea areas, it is expected the emergence of new enterprises with logistical support or even aiming a restructuring in the national sector.

With the emergence in 2009 of a big company, the overall cost structure becomes greatly altered and irregular. The impact of this situation is still making impossible to have a correct cost structure.

The need to differentiate Portuguese products represented a way to the certification of the national production. At this moment we have two mussel farms with certification, namely for organic aquaculture.

The objective of national fisheries policy in regard to aquaculture is to increase and diversified production, in the sustainable mode, to improve the sector's competitiveness.

The processing and marketing of fishery products must respond to changing consumer trends and profiles, seeking to expand and diversify its business, adjusting it to market developments, betting on internationalization and joint control of marketing channels in order to enhance the ability to generate added value. To strengthen this capacity is essential to a strong focus on quality and innovation of processes and products, as well as in the introduction of improvements in the management and organization of enterprises.

Most aquaculture products are for national consumption; however, the export sales are growing, with an increase of 6% to 33% from 2012 to 2016 in the total of sales. Overall sales figures, when compared to the significant investments in aquaculture in the period 2007-2013, seem rather modest. Nevertheless, some investments (notably in a mussels and oyster farms which is about to begin operations) will bring returns in the long term.

Issues of special interest

Many projects were conducted in order to improve new species, methods and technologies which contribute to the increase of the production and to the reduction of environmental impacts of semi-intensive and intensive aquaculture. The proportion of nutrients utilized for fish growth can be maximized, for example by selecting very digestible ingredients that facilitate nutrient assimilation and promote the improvement of FCRs (Feed Conversion Ratios), and at the same time reducing the amount of waste and nutrient output from fish farms (Black 2001, World Bank 2006). Eco-friendly feeds, in which fishmeal protein is replaced by vegetable protein sources, may also contribute to the reduction of aquaculture's ecological footprint by reducing the pressure on natural fisheries resources).

In intensive aquaculture we improved to use recirculation systems (RAS), and in semi-intensive and extensive system we are going to develop the use of multi-trophic system.

The target for the national aquaculture presents a strong growth in the next years, especially concerning the exploitation of new open sea areas and, with the support of the European Fund for Fisheries and Maritime Affairs (EMFF), to achieve until 2023, an increase in productive capability of about 25 000 tonnes.

The significant increase is based on the identification and availability on the Atlantic coast in mainland of new areas of aquaculture production in open sea, the rehabilitation of aquaculture areas of production in areas of estuaries and other wetlands and the betting in systems for intensive production and integrated multi-trophic aquaculture (IMTA).

[13] In Multiannual national plan for the development of sustainable aquaculture *mid-term review 2017.*

Outlook for future production trends

- National strategy on aquaculture

The Strategic Plan for the Portuguese Aquaculture is provided by reference with two strategic guidelines as follows:

- National Strategy for Sea 2013-2020 (ENM 2013-2020);
- Sustainable Development Strategy for European Aquaculture, matter of communication of the European Commission of the European Parliament and of the European Council

The National Strategy for Sea 2013-2020 assumes the ocean as a vector of development established, among others, in the exploitation of marine resources aiming, among other objectives, to reinforce the economic potential of the sea, to increase the contribution to the Gross Domestic Product and reinforce the national scientific and technological capacity.

The action plan to run this Strategy adopts as an objective under the aquaculture "the phenomenon of this activity in line with the consumption growth", in particular for the balance and alignment of production with the needs of consumption.

- To fill in the deficit in capture fisheries is one of the greatest goals of the European Union in order to reinforce the autonomy in terms of food supply, creating, at the same time, wealth and job creation.
- Portugal has natural conditions which, though with some limitations, are adequate for the development of this activity and leads the technology of production in species subject to occupy specific markets. Therefore, the development of the national aquaculture sector, as a way to satisfy an ever growing demand of capture fisheries and the creation of national wealth is a priority.
- Under this context, and considering the National Strategy for the Sea 2013-2020, as well as the strategic guidelines of the European Commission, the development of aquaculture in Portugal has the following guiding principles:
  - The sustainable exploitation of resources using adequate practices to the preservation of the environment;
  - The using of natural resources, in particular open sea spaces, coastal areas, estuaries, reaches and rivers with conditions to aquaculture, favouring the reusing of inactive areas;
  - The institutional involvement, in particular at the level of administrative structures, existing resources under the investigation and development, as well the incentives for private investment;
  - The reinforcement of consumer confidence settled in food quality and food safety of the aquaculture products;
  - The maintenance and development of jobs and quality of life.
- The strategic approach to adopt intends to find solutions which allow overcoming the main constraints conditioning the national aquaculture sector in the period 2014-2020, and supporting the development of an intelligent and ecological aquaculture, competitive one capable of competing at a worldwide level and providing to consumers safe products and of high nutritional value.
- National strategic goal for 2014-2020 is to increase and diversify the offer of products

from national aquaculture, based on principles of sustainability, food quality and food safety, to satisfy the needs of consumption and contributing to local development and employment increase.

1. Main results to achieve

The target for the national aquaculture presents a strong growth in the next years, especially concerning the exploitation of new open sea areas and, with the support of the European Fund for Fisheries and Maritime Affairs (EMFF), to achieve until 2023, an increase in productive capability of about 25 000 tonnes.

The significant increase is based on the identification and availability on the Atlantic coast in Mainland of new areas of aquaculture production in open sea, the rehabilitation of aquaculture areas of production in areas of estuaries and other wetlands and the betting in systems for intensive production and of multi-trophic system.

2. Main bases of strategic intervention

The interventions to reach the strategic goal for the aquaculture sector in Portugal are grouped in three axes, each one of which with specific goals and corresponding actions and/or projects to implement:

- Simplify the administrative proceedings in order to reduce the deadlines and administrative steps needed for the licensing process;
- Facilitate the access to the space and water with the aim to identify spaces with water resources with higher potential for aquaculture and having lesser environmental impact;
- Reinforce the competitiveness of the aquaculture and promote equal conditions for the EU operators, with the aim to increase, diversify and value the national aquaculture production.

The actions foreseen in the National Strategic Plan are financed by EMFF funds registered in Priority 2 of the Operational Program 2014-2020, financial resources and areas of intervention.

According to the Strategic Plan for the Portuguese Aquaculture (2014-2020), despite the relative abundance of water resources in Portugal, especially in marine or brackish water, industry growth rates are limited by the technical conditions and/or natural use existing resources, the spaces available for production and the availability of financing. This growth is also affected by the estimated increase in costs, particularly energy and feed. However, technological development will, in the coming years, enable, on the one hand, the use of spaces and water resources untapped or underexplored.

3. Response to the strategic guidelines

Simplify administrative procedures:

- Set up a website (http://eaquicultura.pt/) containing information related to application submission, analysis and follow up of the permitting and licensing procedures.

Simplification of legislation.

- Preparation of clearer administrative procedures for key areas identified as problematic by industry.

Coordinated spatial planning:

- Improving the legal and regulatory framework for aquaculture in Portugal.

- Development of existing instruments for territorial management.
- Identification and creation of new aquaculture production areas.

Enhance competitiveness:

- Increase in and diversification of production and supply of new products, including the installation of new units and/or modernization of existing ones.
- Investment in production methods to ensure high food safety standards.
- Research on offshore aquaculture, identifying coastal areas, species and suitable production systems.

Level playing field:

- Support for the creation, organisation and functioning of the Producer Organizations;
- Promoting partnerships between the sector, industry and distribution and marketing chains;
- Monitoring and improvement of statistical information.

4. Best practices

The Plan identifies a number of examples of best practice covering different species, production systems and scales, including:

- Preservation of fresh water endemic species, which are threatened with extinction due to the variation of the flow of small rivers and streams of the south of Portugal.
- Evaluate potential impacts on the production of clams due to environmental changes in Ria Formosa (Algarve).

- The Operational program of EMFF

The promotion of a competitive aquaculture, economically viable, socially and environmentally sustainable, will be supported by the Operational Programmer 2014-2020, with this Strategic Plan, ex-ante conditionality.

The vast majority of actions set out in this Strategic Plan will be financed through the EMFF funds in Priority 2 of the Operational Programmer 2014-2020.

The following table refers to the use of the EMFF funds provided for in Priority 2 to support the actions developed under the Strategic Plan.

Table 4.21.5 EMFF USING THE OP 2014-2020.

Intervention areas	Interveners	Resources of the EMFF
Planning Space and Access to Water	Public entities	€4 million
Productive investments	Aquaculture companies	€36.5 million
Research & Development	Sector Scientific and Technological	€7.5 million
Sustainability Activity	Public entities and Aquaculture Companies	€9 million
Training and Dissemination of Knowledge	Scientific entities, Training, Business and Sector Associations	€2 million

The EMFF contribution for the period 2014-2020, for sustainable aquaculture is €59 000 thousand, represents 15% of the total EMFF for Portugal.

The Strategic Plan for the Portuguese Aquaculture 2014-2020 (PEAP) and Operation Program (OP) PO MAR 2020 contain both a SWOT analysis, verifying that all points strong, weaknesses, opportunities and threats of the PEAP analysis are in SWOT OP. Consequently, the results of the SWOT analysis within the PEAP are answered in the OP project, verifying that all the measures provided for in PO corresponding item in the main actions envisaged in the Strategic Plan for Portuguese aquaculture (PEAP).

The identification of the most suitable areas for the installation of aquaculture establishments and the development of the activity in line with the preservation of the environment may be supported by measures aimed at increasing potential areas for aquaculture.

The needs identified in the SWOT analysis are in correspondence with intervention axes defined in PEAP, in particular with regard to the order spaces dedicated to aquaculture and public investment effort (especially in innovation) and private, in order to increase the domestic supply of quality aquaculture products. It should be noted that the simplification of the regulatory framework of aquaculture activity, although not subject to co-financing by the EMFF, it is an action of the Strategic Plan crucial to its success in the field of aquaculture, and is already being implemented since April 2017.

In addition to the actions of the PEAP funded under Priority 2 of the OP 2014-2020 other actions relevant to the aquaculture sector may also be support object of this program through other priorities, particularly in terms of spreading the benefits of fish consumption and promoting the quality of aquaculture products, support for the establishment or operation of producer organizations and improve the tools for collecting statistical data.

4.21.6 Data Coverage and Data Quality

Data quality

The account statistics for 2016 is based on a census on the 1.402 aquaculture farms. The operation is carried out annually during the month of May.

The Portuguese Directorate General for Natural Resources, Security and Maritime Services (DGRM) has registered the total population of farms and enterprises engaged in aquaculture production in Portugal. It is mandatory for all aquaculture producers in Portugal to report the production in volume and value each year at the farm level. The operation of data collection was expanded in order to fulfil the needs of DCF and socio-economic data is now collected. The same operation fulfils the administrative needs for information, EUROSTAT and DCF. The data are collected at farm level in production.

While production data is mandatory, economic data are provided voluntarily. The low rate of responses is a tendency in the last years and the administration is enforcing the response with some administrative measures that include sanctions if production is not delivered one year and may include the removal of the license in case of non-response for 2 years.

Due to the low response rates, the variables are estimated to reach the whole population and quality indicators calculated.

Data for the aquaculture sector is published once a year aggregated by type of farm and species. The aquaculture statistics are published on an annual publication, "Estatísticas da Pesca", in collaboration between DGRM and the Portuguese National Statistics Institute (INE) approximately 18 months after the end of the reference year.

Confidentiality

Confidentiality rules are applied when the number of units in a segment in less than 3. In this case units are aggregated, when possible, to a similar segment, under the statistical evidence that both populations are homogeneous. When aggregation is not possible, data provided doesn't include the confidential values and may not include other values if it's possible to achieve that information by subtracting totals to the known segments.

Differences in DCF data compared with other official data sources

The Portuguese data collection uses the same database to provide information to Eurostat, FAO and DCF. Differences in the data results from the aggregation requested by different data calls and the time of the year when data is provided. When data changes (new data are received or re-submission of data by some enterprises), new sets are compiled and disseminated to the different end users, accordingly to data revision policies. Other than this, differences between sources should not happen.

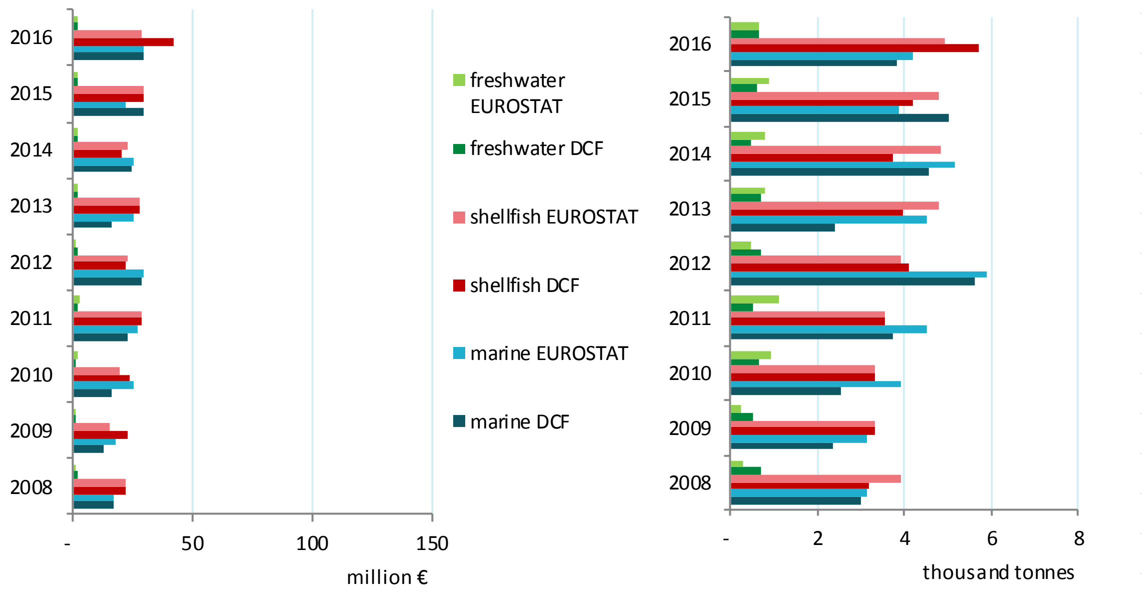


Figure 4.21.10 Comparison of DCF data with EUROSTAT data for Portugal: 2008-2016

4.22 Romania

Although not landlocked, Romania only produces freshwater aquaculture products. The analysis below is based on the EUROSTAT data. However, EUROSTAT does not provide information for volume and value for 2016.

Production volume and value

Data retrieved from the FAO database on aquaculture production indicate that the Romanian aquaculture sector produced 12 554 tonnes in 2016 which corresponded to an increase of 12% from 2015 to 2016.

The main product reported to FAO for the Romanian aquaculture sector are Common carp, Silver carp, Bighead carp and Rainbow trout with reported volume of production 4 841, 2 364, 2 121 and 1 109 tonnes respectively in 2016.

Table 4.22.1 Production and sales for Romania: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016
Production weight (thousand tonnes)	***12.5***	***13.1***	***8.8***	***8.4***	***10.0***	***10.1***	***10.7***	***11.0***	
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Freshwater	12	13.1	8.8	8.4	10.0	10.1	10.6	11.0	
Production value (million €)	***18.1***	***17.0***	***5.6***	***15.9***	***18.1***	***20.6***	***19.3***	***21.8***	
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Freshwater	18.1	17.0	5.6	15.9	18.1	20.6	19.2	21.7	
Hatcheries & nurseries (million units)	***17***	***0***	***658***	***0***	***0***	***3***	***297***	***0***	***92***
Eggs	0	0	0	0	0	0	296	0	1
Juveniles	17	0	658	0	0	3	1	0	91

SOURCE: EUROSTAT, 2018

4.22.1 Data Coverage and Data Quality

According to the information provided in the Romanian Annual Report 2017 the data were collected for 2016 and could be available from May 2018. Nonetheless, the data was not submitted in time for the report.

The expert advice for more detailed analysis cannot be provided in the chapter due to the absence of an expert from Romania at the experts meeting.

4.23 Slovakia

Production volume and value

The Slovakian aquaculture production consisted of 1 957 tonnes in 2016, solely from freshwater species and reached the highest level since 2008. Annual increase from 2015 to 2016 amounted 57%. The recovery of production since the lows in 2010 was partially related with improved economic situation. High correlation was observed with the GDP per capita (Eurostat data), when it decreased in 2008-2010 years and from 2010 to 2016 recovered to the highest number.

The same trend for value of production was observed for the 2008-2016 period, when value significantly dropped by 40.7% from 2008 to 2010 and significantly recovered to the highest value in 2016, reaching €4.9 million. Despite the lowest production volume and value in 2010, at that time the average production price was highest within five-year long period. Turnover from low production volume was increased by rising prices and contrary, in 2016 increased production supply negatively affected prices with the 13% annual decline.

Whilst no marine or shellfish aquaculture is produced due to the landlocked nature of Slovakia there were production of fish eggs and juveniles. In 2014, they amounted to €256 million, a 49% decrease regarding the period 2008-2014.

Table 4.23.1 Production and sales for Slovakia: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 15-16	Develop. 2016/(08-15)
Production weight (thousand tonnes)	***1.1***	***0.8***	***0.6***	***0.9***	***1.3***	***1.1***	***1.2***	***1.2***	***2.0***	***57%***	***91%***
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Freshwater	1.1	0.8	0.6	0.9	1.3	1.1	1.2	1.2	2.0	*57%*	*91%*
Production value (million €)	***2.7***	***1.8***	***1.6***	***2.4***	***3.2***	***3.2***	***3.2***	***3.6***	***4.9***	***37%***	***80%***
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*
Freshwater	2.7	1.8	1.6	2.4	3.2	3.2	3.2	3.6	4.9	*37%*	*80%*
Hatcheries & nurseries (million units)	***42***	***38***	***33***	***39***	***43***	***17***	***0***	***0***	***0***	***0%***	***-100%***
Eggs	27	31	26	27	25	10	0	0	0	*0%*	*-100%*
Juveniles	15	7	7	12	18	7	0	0	0	*0%*	*-100%*

SOURCE: EUROSTAT

Main segments

Rainbow trout was the main species produced by the Slovakian aquaculture sector, representing 55% in total volume and 67% of total value of sector production. Second biggest segment is Freshwater fishes nei with the 24% of the weight and 17% of the production value. Other segments could be considered of minor importance and consists of species as common carp and silver carp.

Rainbow trout average first-sale prices in Slovakia were €3.1 per Kg in 2016, first-sale price for common carp price was €2.3/Kg. Prices for main target species, rainbow trout and Freshwater fishes nei had a different trend in 2016. Rainbow trout average price remains relative stabile between 2015 and 2016. Freshwater fishes nei on the other hand, recorded a drop in prices for 47% in 2008-2014 period (from €3.2/kg to €1.7/kg).

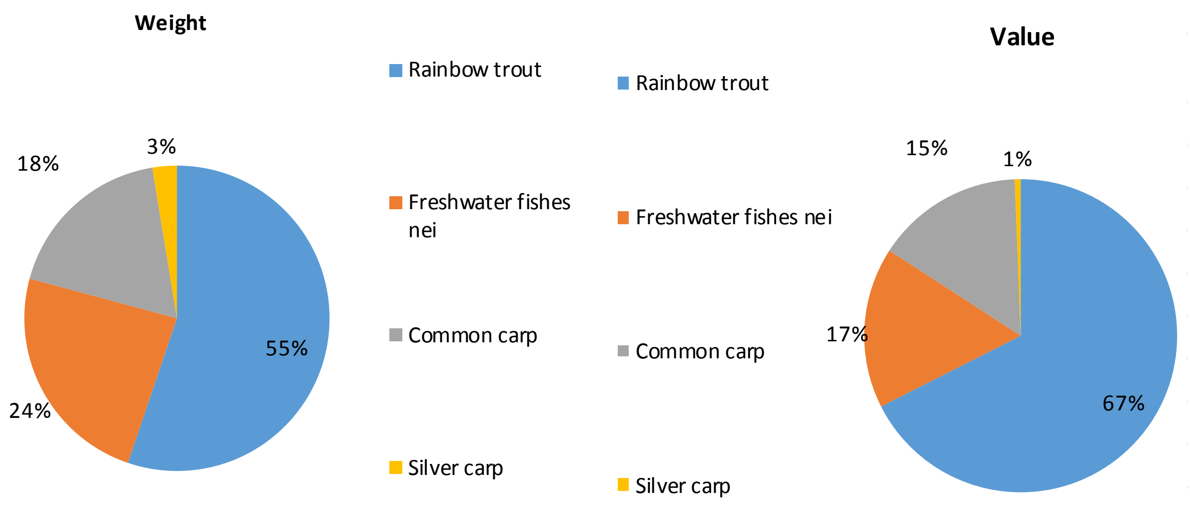


Figure 4.23.1 Main species in terms of weight and value in Slovakian production: 2016.
Source: EUROSTAT

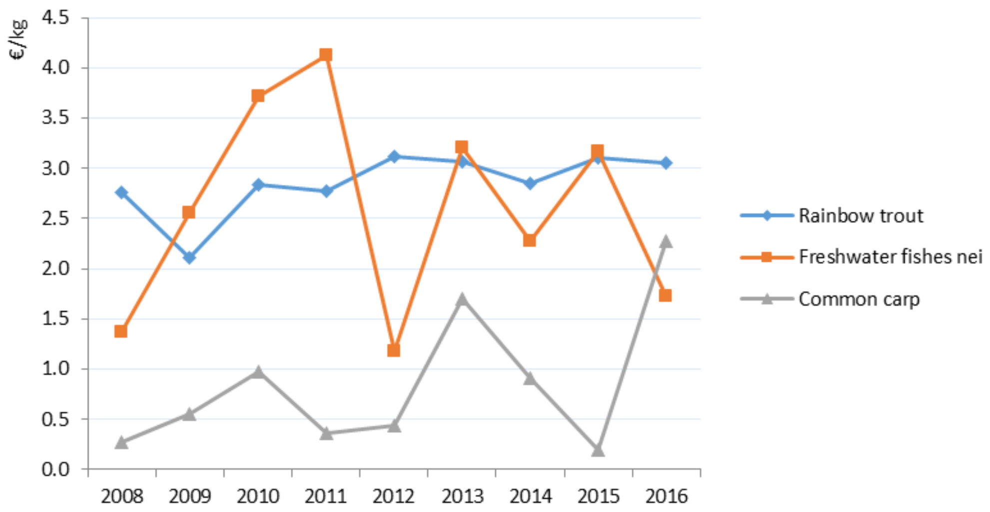


Figure 4.23.2 Average prices for the main species produced in Slovakia: 2008-2016.
Source: EUROSTAT

Trend and trigger /Outlook

Increased volumes and stable prices of Rainbow trout in Slovakia demonstrate high importance and perspective outlook for near future in country aquaculture sector. As an example in 2016, when supply was increased with a same price, compare to 2015. Supply for Rainbow trout could be considered as demand driven. Quite different price performance was observed in Freshwater fishes nei segment, when significantly increased quantities of production pushed prices down what could be considered as supply driven.

4.23.1 Data Coverage and Data Quality

Slovakia is a landlocked country and only produces freshwater aquaculture. Because freshwater data is not compulsory under the DCF, landlocked countries were not requested to collect data under the DCF regulation. Because of the lack of DCF data for Slovakia, FAO and EUROSTAT data were used in this analysis.

4.24 Slovenia

4.24.1 Production and sales

In 2016 were six companies in Slovenia dealing with shellfish farming, primarily with mussel farming (Mediterranean mussel). The shellfish are farmed using hanging ropes that are attached to rafts.

In the same year were only one company that was engaged in breeding of fish. A main space for breeding is sea bass. Main farming techniques is breeding in cages.

Table 4.24.1 Production and sales for Slovenia: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/ (08-15)
Sales weight (thousand tonnes)	***0.3***	***0.4***	***0.1***	***0.5***	***0.4***	***0.4***	***0.5***	***0.6***	***0.7***	*5%*	*67%*
Marine	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.0	*-50%*	*-52%*
Shellfish	0.2	0.3	0.1	0.4	0.3	0.3	0.5	0.6	0.6	*10%*	*87%*
Freshwater											
Hatcheries & nurseries											
Sales value (million €)	***0.5***	***0.7***	***0.3***	***0.5***	***0.7***	***0.6***	***0.8***	***0.8***	***0.9***	*12%*	*37%*
Marine	0.4	0.5	0.3	0.3	0.4	0.2	0.4	0.3	0.1	*-50%*	*-61%*
Shellfish	0.1	0.2	0.0	0.2	0.4	0.4	0.4	0.5	0.7	*44%*	*156%*
Freshwater											
Hatcheries & nurseries											

Source: EU Member States DCF data submission

In 2015 the marine aquaculture turnover was €771 335, in 2016 the same turnover increased by almost 12% and amounted €860 413. The total sales volume also increased by 5% from 2015 to 2016 and it was 643 tonnes in 2015 and 675 tonnes in 2016.

The main segments in the Slovenian marine aquaculture sector are Sea bass & Sea bream cages (seg3.4) and Mussel rafts (seg7.1).

4.24.2 Industry structure and employment

Aquaculture in Slovenia comprises freshwater aquaculture (cold-water fish farming of salmonids and warm-water fish farming of cyprinids) and mariculture (fish and shellfish farming). Warm-water and cold-water fish farming has been practiced since the end of nineteenth century, while mariculture has a shorter history: it started at the end of the twentieth century. The major species contributing most of the production value in freshwater fish farming are rainbow trout (*Oncorhynchus mykiss*) and common carp (*Cyprinus carpio*), whilst in mariculture it is Mediterranean mussel (*Mytilus galloprovincialis*) and European seabass (*Dicentrarchus labrax*).

Mariculture practice is traditional. Fish farming takes place in cages submerged into the sea, while mussel farming takes place in a standard manner in lines of floating buoys linked together, with longline nets hung from them. In 2007, three larger areas were designated for marine aquaculture in Slovenian territorial waters that were subsequently separated into 22 plots, for which concessions were granted for the use of marine water in 2009. It is expected that these plots will not be able to expand, due to the use of Slovenian territorial waters for other purposes. Currently, all the concessions for using marine water for the breeding of marine organisms have been granted, two of them for breeding marine fish and 20 for breeding shellfish. The total area for breeding fish at sea (excluding shellfish farming) in 2016 was 5 663 m2 (two plots). The area of the 20 plots at sea that are used for shellfish farming was 45.1 ha.

Due to natural circumstances, the development of marine fish farming in Slovenia is limited. Mariculture takes place in the Bay of Strunjan, the Bay of Debeli rtič (shell-fish farming) and in the Bay of Piran (fish and shell-fish farming).

Mariculture shellfish farming is more important than fish farming regarding the total volume of sales. Shellfish farming accounts for 96% of total mariculture production in 2016. The production of European seabass is more important than the production of gilthead seabream. It contributes around 4% to total mariculture production in 2016.

Since the early eighties (1982) the production of the Mediterranean mussel (*Mytilus galloprovincialis*) has been increasing and in 1988 it reached a maximum of 703 tonnes. After that year a significant decline was due to the fact that exports to Italy ceased. In 1995 the production of mussels reached a minimum of 12 tonnes. In recent years, there are increases in production, particularly due to the resolution of the status of shellfish production facilities through the granting of concessions for the use of marine water: first in 2001 and then in 2003, when production reached 135 tonnes, the highest since 1992. There was also a peak in production in 2016, with 648 tonnes of Mediterranean mussels produced. Current production covers mainly the needs of the domestic market. In recent years, especially in 2010, considerable difficulties occurred in the production of shellfish due to the frequent closures of sales because of the occurrence of biotoxins, which prevents shellfish farms to be used to their full production capacity. Damage on shellfish farms caused by wild fish, especially by sea bream, also presents major problems in the last few years.

In 2011, also with the help of EMFF funds, Slovenian mussel sector commenced with production of Warty Venus. In the year 2012 sales volume of Warty Venus amounted 5.83 tonnes, while in 2016 sales volume increase to almost 35 tonnes.

From 1991 onwards intensification was carried out especially with farming European seabass and seabream in the Bay of Piran. A first result of seabass production in 1992 was 5.7 tonnes. In subsequent years, annual variations in production (growth and decline) were noted. In 2001 production reached its maximum with 59 tonnes, and very similar amounts were noted in 2003. Here, there was a peak in production in 2014, with 66 tonnes of seabass.

The first results of seabream production in 1992 were 4 tonnes. In the following years there was a growth in production, with some variations, until 1997 when production reached a maximum of 61 tonnes. After that year production declined and reached a minimum of 6 tonnes in 2001. In 2003, production was 16 tonnes. From 2010 to 2016, there was no production of seabream.

Slovenia is a net importer of fish and fish products. In 2016 imports were approximately four times larger than exports. There is a continuous import of fresh farmed species: seabream, seabass and salmon. The majority of the imported fish products come mainly from the European Union and are frozen, dried or processed.

Table 4.24.2 Structure of the Slovenian aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/ (08-15)
Structure (number)											
Total enterprises	*11*	*11*	*13*	*11*	*11*	*8*	*7*	*7*	*7*	*0%*	*-29%*
<=5 employees	10	10	11	9	8	5	6	6	6	0%	-26%
6-10 employees	1	0	1	1	1	3	1	1	1	0%	-11%
>10 employees	0	1	1	1	2	0	0	0	0		-100%
Employment (number)											
Total employees	*29*	*35*	*31*	*32*	*34*	*32*	*20*	*21*	*20*	*-5%*	*-32%*
Male employees	27	33	26	26	28	24	16	13	12	-8%	-50%
Female employees	2	2	5	6	6	8	4	8	8	0%	56%
FTE	26	32	28	28	28	27	19	20	20	-1%	-24%
Male FTE	24	30	23	23	22	19	15	12	12	-3%	-44%
Female FTE	2	2	5	4	6	7	4	8	8	1%	67%
Indicators											
FTE per enterprise	2.4	2.9	2.1	2.5	2.5	3.3	2.7	2.8	2.8	-1%	5%
Average wage (thousand €)	21.5	19.7	16.1	20.4	19.7	19.3	14.5	11.2	9.5	-15%	-47%
Labour productivity (thousand €)	85.8	66.1	86.0	179.6	104.3	86.3	35.6	71.5	42.4	-41%	-53%

Source: EU Member States DCF data submission

In 2016 Slovenia had six companies with five or less employees and one company with six to ten employees. The status in employment reflects the situation in the aquaculture sector whereby the majority of small family farms operates with self-employed people, mostly one employee. Total employment in 2016 was estimated at 20 jobs, corresponding to 19.6 FTEs. The level of employment decreased between 2008 and 2016, with total employed decreasing by 32% while the numbers of FTEs decrease by 24% over the period. With respect to the gender of those in employment, men are predominated in aquaculture sector. In 2016 eight women (40%) were involved. Average salary per FTE employees in 2008 was €21 513. In 2016 average salary per FTE employees decrease for approximately 56% regarding 2008 and amounted €9 492.

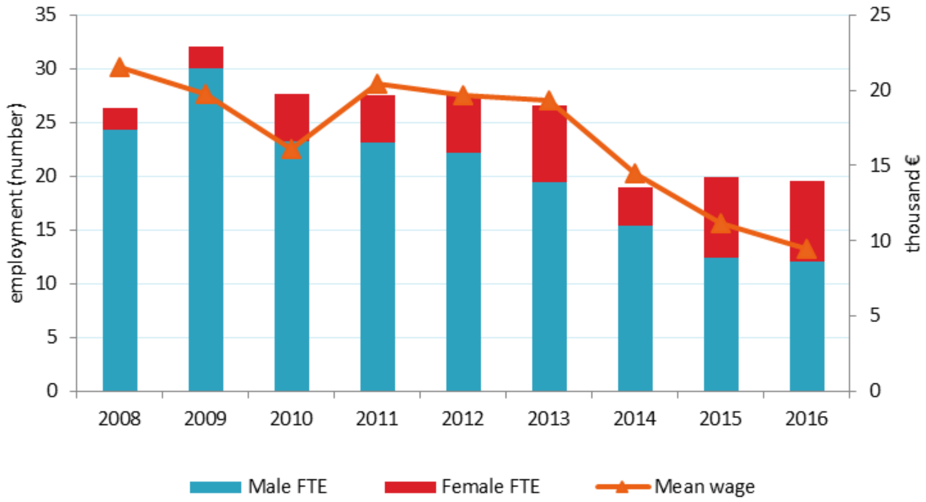


Figure 4.24.1 Employment trends for Slovenia: 2008-2016.
Source: EU Member States DCF data submission

The number of enterprises decreased from 2008 to 2016, but the average number of FTE per enterprise has been rather constant over the period. At the same time, also the labour productivity has been decreasing for 53%. In the period 2012-2016 Slovenian aquaculture sector underwent major structural changes. Some of the larger companies that are dealing with different types of activities, separated aquaculture from other activities formed new smaller companies which are exclusively engaged in aquaculture. Consequently, the share of other income in total income has decreased in the period 2012-2016 for almost 70%. This had impact on lower labour productivity in the period mentioned. The structural changes made in Slovenian aquaculture sector had negative impact also in employment trends and average wage in period 2012-2016.

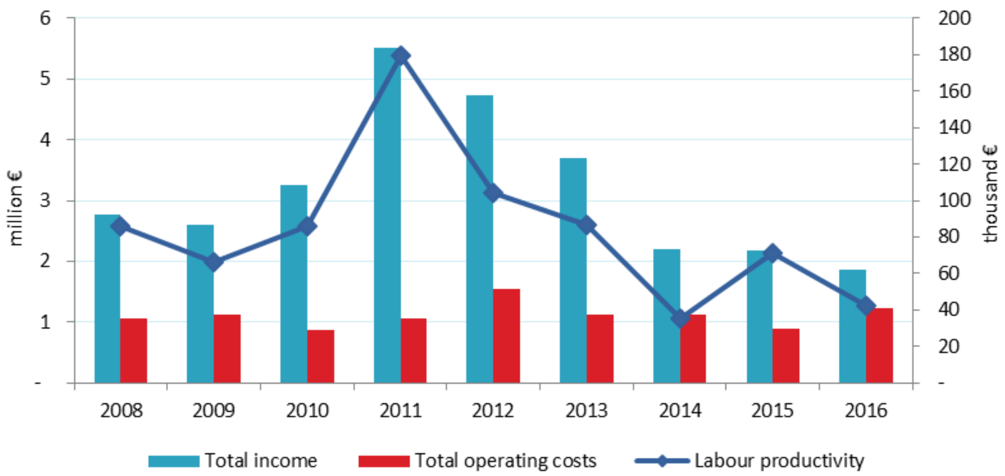


Figure 4.24.2 Income, costs, wages and labour productivity trends for Slovenia: 2008-2016.
Source: EU Member States DCF data submission

The total amount of income generated by the Slovenian aquaculture sector in 2016 was €1.9 million. This consisted of €0.9 million in turnover and €1.0 million in other income (Figure 4.24.2 and Table 4.24.3). The total income of the Slovenian aquaculture sector decreased by 14% between 2015 and 2016, while turnover increased by 12% in the same period. The reasons for decreasing value of total income are in other income which decreases for almost 24% and in subsidies which were not accepted in 2016.

All the firms in Slovenian aquaculture sector are registered to practice aquaculture and aquaculture should be their main source of income, however large part of the income still gain from carrying out other activities, such as scuba diving, underwater work, marketing, etc.

4.24.3 Economic performance

Table 4.24.3 Economic performance of the Slovenian aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	*% of total income*	Change 2016-15	Development 2016/(2008-15)
Income (million €)												
Turnover	0.5	0.7	0.3	0.5	0.7	0.6	0.8	0.8	0.9	*46%*	*12%*	*37%*
Other income	2.2	1.9	2.5	4.9	3.2	2.3	0.7	1.3	1.0	*54%*	*-24%*	*-58%*
Subsidies	0.0	0.0	0.4	0.1	0.8	0.8	0.7	0.1	0.0	*0%*	*-100%*	*-100%*
Total income	*2.8*	*2.6*	*3.2*	*5.5*	*4.7*	*3.7*	*2.2*	*2.2*	*1.9*	*100%*	*-14%*	*-44%*
Expenditures (million €)												
Wages and salaries	0.6	0.6	0.4	0.6	0.5	0.5	0.3	0.2	0.2	*10%*	*-16%*	*-60%*
Imputed value of unpaid labour	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*	*0%*
Energy costs	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	*4%*	*-26%*	*-17%*
Repair and maintenance	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	*3%*	*-32%*	*25%*
Raw material: Feed costs	0.2	0.2	0.1	0.2	0.3	0.3	0.1	0.1	0.3	*14%*	*83%*	*28%*
Raw material: Livestock costs	0.1	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.1	*7%*	*52%*	*12%*
Other operational costs	0.0	0.0	0.1	0.0	0.2	0.1	0.5	0.2	0.5	*26%*	*105%*	*223%*
Total operating costs	*1.1*	*1.1*	*0.9*	*1.1*	*1.5*	*1.1*	*1.1*	*0.9*	*1.2*	*65%*	*36%*	*11%*
Capital Costs (million €)												
Depreciation of capital	0.1	0.1	0.2	0.3	0.5	0.7	0.9	0.7	0.7	*38%*	*8%*	*61%*
Financial costs, net	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.0	0.1	*3%*	*33%*	*-47%*
Extraordinary costs, net	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	*1%*	*-8%*	*-70%*
Capital Value (million €)												
Total value of assets	3.2	3.1	4.6	6.9	10.2	8.2	8.7	7.9	7.6	*406%*	*-4%*	*15%*
Net Investments	0.1	0.0	0.3	1.5	1.9	3.1	1.0	0.9	0.0	*0%*	*-100%*	*-100%*
Debt	2.5	2.5	3.6	5.4	6.2	3.7	3.7	4.6	2.5	*132%*	*-47%*	*-39%*
Input & Production (thousand tonnes)												
Raw material: Feed	0.2	0.2	0.1	0.2	0.3	0.3	0.1	0.1	0.2		*84%*	*16%*
Raw material: Livestock	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.0		*-97%*	*-92%*
Performance Indicators (million €)												
Gross Value Added	2.3	2.1	2.4	4.9	2.9	2.3	0.7	1.4	0.8	*45%*	*-41%*	*-65%*
Operating cash flow	1.7	1.5	2.4	4.5	3.2	2.6	1.1	1.3	0.6	*35%*	*-49%*	*-71%*
Earning before interest and tax	1.6	1.4	2.2	4.1	2.6	1.8	0.2	0.6	-0.1	*-4%*	*-112%*	*-104%*
Net profit	1.5	1.3	2.0	3.9	2.5	1.7	0.1	0.6	-0.1	*-7%*	*-124%*	*-108%*
Capital productivity (%)	71.2	69.3	51.3	71.3	28.2	27.9	7.7	18.0	11.0		*-39%*	*-75%*
Return on Investment (%)	49.9	45.1	47.4	59.3	25.8	22.4	2.1	7.7	-1.0		*-113%*	*-103%*
Future Expectation Indicator (%)	-1.4	-2.4	3.1	16.4	13.6	28.6	1.6	3.6	-9.5		*-363%*	*-220%*

Source: EU Member States DCF data submission

Total operating costs by the Slovenian aquaculture sector in 2016 was €1.2 million. The largest expenditure items were Other operational costs (€0.5 million) and Raw material: Livestock costs (€0.3 million) (Table 4.24.3). The total operating costs remains relatively stable from 2008-2016, with exceptional in 2012 when was a peak with €1.5 million.

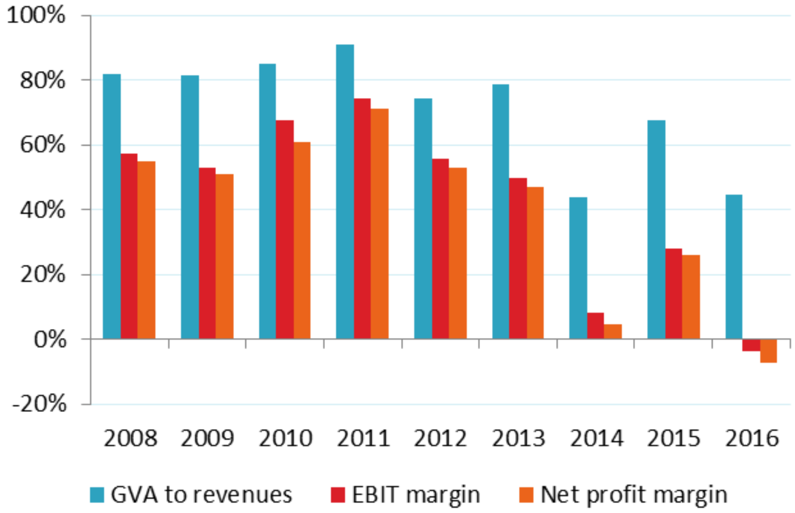


Figure 4.24.3 Economic performance for Slovenia: 2008-2016
Source: EU Member States DCF data submission

In terms of economic indicators, the amount of GVA, OCF, EBIT and Net profit generated by the Slovenian aquaculture sector in 2016 was €0.8 million, €0.6 million, €-0.1 million and €-0.1 million respectively, see Table 4.24.3. Values of all economic indicators are decreased from 2015, namely due decreased value of other income in 2016.

4.24.4 Main species produced and economic performance by segment

The most relevant segments in the Slovenian marine aquaculture are:

- Segment 1: Sea bass & Sea bream cages (seg3.4);
- Segment 2: Mussel rafts (seg7.1).

They are two main segments in the Slovenian marine aquaculture sector; Sea bass & Sea bream cages (seg3.4) and Mussel rafts (seg7.1). The most important species are Mediterranean mussel and European seabass.

In terms of sales volume mariculture shellfish farming are more important than fish farming. The major cultured shellfish species, Mediterranean mussel, accounts for 91% of total sales volume in 2016. The production of European seabass is more important than the production of gilthead seabream. It contributes around 4% to total mariculture production in 2016.

In terms of sales volume, sales volume of the Mussel rafts segment represents 96% of the total sales volume of Slovenian aquaculture sector in 2016. Turnover from this sector represent 84% of the total turnover in the same year. In the Mussel rafts sector were 10.6 FTE employees in 2016, which represent 54% of all FTE employees in Slovenian aquaculture sector in the same year.

In 2011, also with the help of EMFF funds, Slovenian mussel sector commenced with production of Warty Venus. In the year 2012 sales volume of Warty Venus amounted 5.83 tonnes, while in 2016 sales volume increase to almost 35 tonnes. Income of Warty Venus represent, because of very high first sales price of around €11/kg, more than 50% of all income from Mussels sector in

2016. On the other hand, sales volume of Warty Venus represents less than 6% of all sales volume from Mussels sector in the same year.

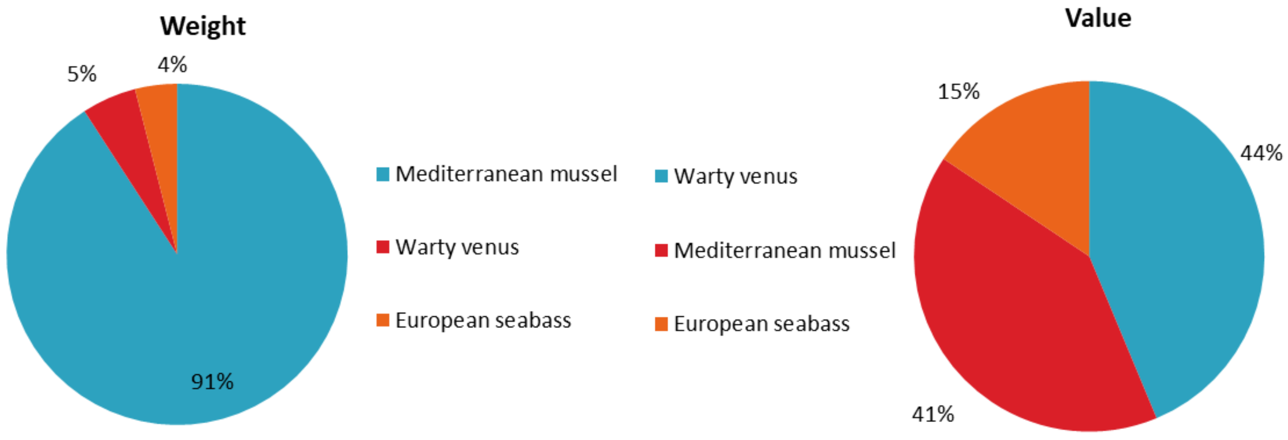


Figure 4.24.4 Main species in terms of weight and value in Slovenian production: 2016.
Source: EU Member States DCF data submission

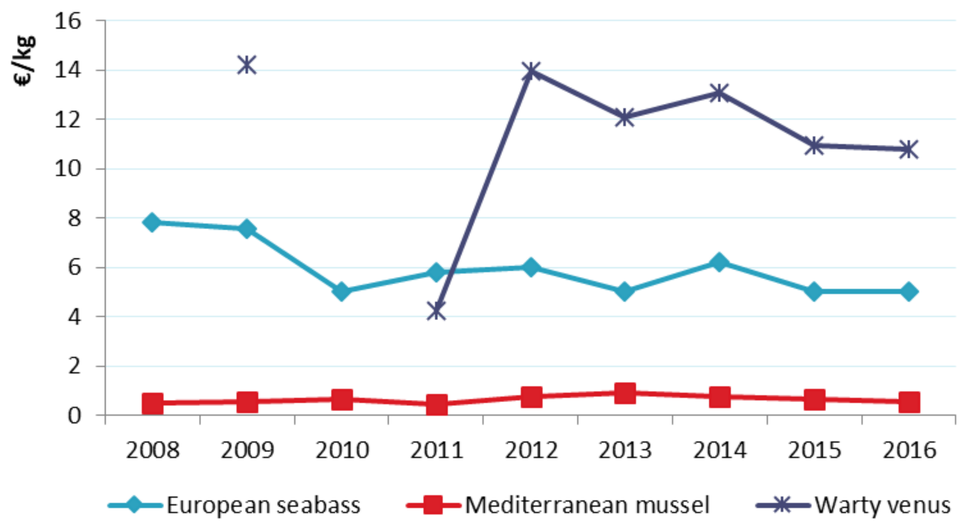


Figure 4.24.5 Average prices for the main species produced in Slovenia: 2008-2016.
Source: EU Member States DCF data submission

The highest average price on the market achieves Warty venus with amount of €10.79/kg. The average price of European seabass was €7.81/kg in 2008. In 2016 average price decrease by 36% regarding 2008 and amounted €5.00/kg. The main reason for decreased price of seabass is increased imports of seabass, mainly from Greece and Croatia, where the first-sales price is lower than in Slovenia. The average price of Mediterranean mussel was €0.57/kg in 2016 and remains relatively stable from 2008-2016, with exceptional in 2012 and 2013 when was a peak with €0.76 (2012) and €0.91 (2013).

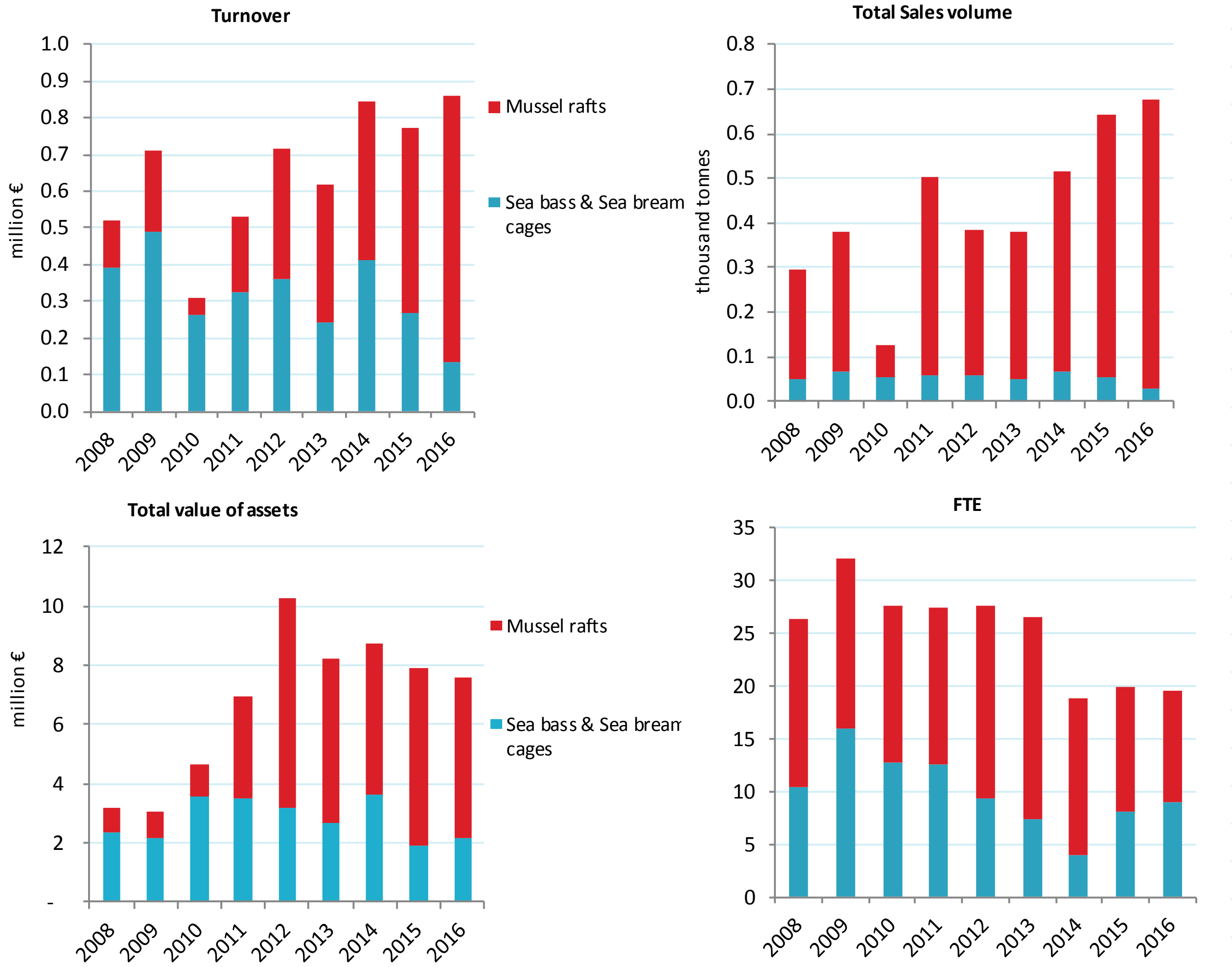


Figure 4.24.6 Structural development Slovenian aquaculture sector: 2008-2016.
Source: EU Member States DCF data submission

In Table 4.3.4, because of the confidentiality issues, only the economic performance of the Mussel rafts segments is shown. From the table it can be seen that the gross value added is positive in the period from 2008 to 2016, while net profit is negative in the last two years. One of the reasons for negative net profit can be also high values of depreciation costs over a past few years. Slovenian Mussel rafts sector has over the past few years, with the help of EU Funds, invested significantly in the new equipment and production facilities. So these new investments are the main reason for increased value of Depreciation of capital.

Table 4.24.4 Economic performance of main Slovenian aquaculture segments: 2008-2016 (in million €).

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	*% of total income*	Change 2016/15	Development 2016/(2008-15)
Mussel rafts												
Total income	*1.2*	*1.4*	*1.6*	*3.7*	*4.2*	*3.4*	*1.5*	*0.9*	*1.1*	*100%*	*28%*	*-50%*
Gross Value Added	*1.1*	*1.3*	*1.4*	*3.5*	*3.1*	*2.5*	*0.6*	*0.5*	*0.6*	*52%*	*24%*	*-67%*
Operating cash flow	*0.8*	*1.0*	*1.3*	*3.2*	*3.4*	*2.8*	*1.0*	*0.3*	*0.4*	*36%*	*15%*	*-77%*
Earning before interest and tax	*0.8*	*0.9*	*1.3*	*3.1*	*2.9*	*2.3*	*0.3*	*-0.3*	*-0.3*	*-26%*	*-7%*	*-121%*
Net profit	*0.7*	*0.9*	*1.2*	*3.1*	*2.8*	*2.2*	*0.2*	*-0.3*	*-0.3*	*-30%*	*-15%*	*-125%*
Total sales volume (thousand tonnes)	*0.2*	*0.3*	*0.1*	*0.4*	*0.3*	*0.3*	*0.5*	*0.6*	*0.6*		*10%*	*87%*

Source: EU Member States DCF data submission

In terms of sales volume, sales volume of the Mussel rafts segment represents 96% of the total sales volume of Slovenian aquaculture sector in 2016. Turnover from this sector represent 84% of the total turnover in the same year. In terms of other economic indicators, the amount of GVA, OCF, EBIT and Net profit generated by the Slovenian Mussel rafts sector in 2014 was €0.6 million, €0.4 million, €-0.3 million and €-0.3 million respectively, see Table 4.3.4 Despite increased productions of Mediterranean mussel as the most important species in this segment the values of all economic indicators in Mussel rafts sector are decreased substantially from 2008. Main reason for decreasing of economic indicators is decreased in other income due major structural changes in the sector. In terms of sales volume and value, Mediterranean mussel represents 95% and 48% of the total sales volume and value of the Mussel rafts segment.

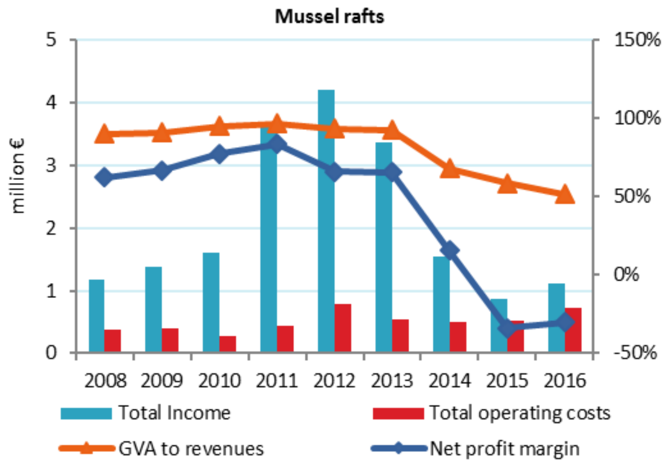


Figure 4.24.7 Economic performance indicators for the main Slovenia segments: 2008-2016.
Source: EU Member States DCF data submission

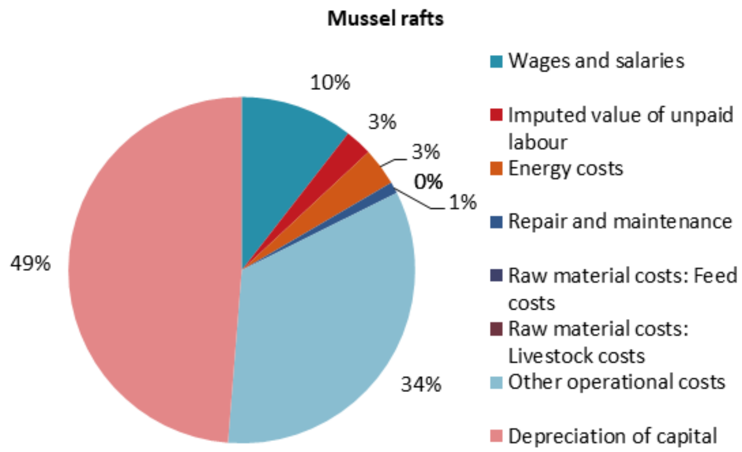


Figure 4.24.8 Cost structure of the main segments in Slovenia: 2016.
Source: EU Member States DCF data submission

The largest cost item of Mussel rafts sector in 2016 were the Depreciation of the capital, accounted for 49% of the total operational costs. Other operation costs made up 34% of all operational costs. In 2016, Depreciation of the capital increases by 12% regarding 2015 and by 1690% regarding 2008. Slovenian Mussel rafts sector has over the past few years, with the help of EU Funds, invested significantly in the new equipment and production facilities. So these new investments are the main reason for increased value of Depreciation of capital.

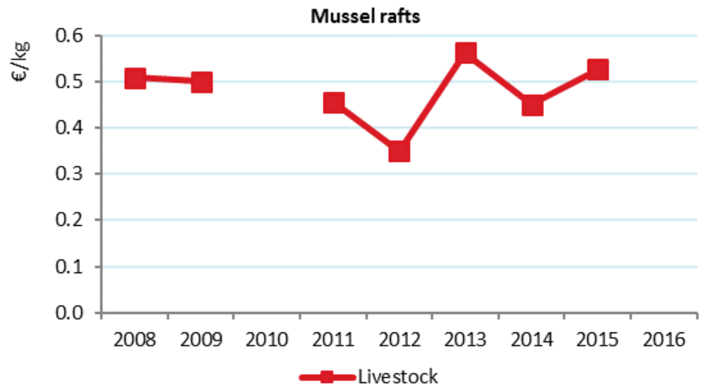


Figure 4.24.9 Feed and livestock prices for the main Slovenian segments: 2008-2016.
Source: EU Member States DCF data submission

4.24.5 Trends and triggers

Current production trends and main drivers

Market structure

Slovenian market for marine products is fragmented and disorganized. A large number of producers and dealers are unorganized and acting individually. For all these reasons they achieve a lower first sales price and higher operating costs and are therefore non-competitive with foreign suppliers. Slovenia is a net importer of fish and fish products. In 2016 imports were approximately four times larger than export and amounted to 17 285 tonnes (€90.4 million) of fish and other fish product. On the other hand, export amounted to 4 789 tonnes (€26 million) in the same year. The majority of the imported fish and fish products come mainly from European Union. The largest Slovenian seafood import partners are Italy, Spain and Croatia. Concerning export, the largest partners are Austria, Croatia and Bosnia and Herzegovina.

There is a continuous import of fresh farmed species: seabream, seabass and salmon. The majority of the imported fish products come mainly from the European Union and are frozen, dried or processed.

Issues of special interest

The Ministry of Agriculture, Forestry and Food (MAFF) is responsible for fisheries and aquaculture in Slovenia. Fisheries comprise capture fisheries, aquaculture of fish and other water animals and trade in fisheries products. Inland fisheries, fish farming and fish health are managed by three main Acts: the Freshwater Fishery Act, the Livestock-breeding Act (ZŽiv) and the Veterinary Service Act (Zvet) and their regulations, ordinance, etc. Marine fisheries, fish and mussel farming are regulated by Marine Fisheries Act (ZMR-2). In fisheries and aquaculture, it is necessary to take into consideration the Environment Protection Act (ZVO), the Nature Conservation Act (ZON), and the Water Act (ZV).

The main leading government agency in fisheries and aquaculture is the Directorate of Forestry, Hunting and Fisheries within the Ministry of Agriculture Forestry and Food. The main task of the Directorate is to provide overall administrative control of aquaculture and fisheries, to ensure an adequate legislative framework for aquaculture and fisheries, and to carry out related legislative tasks. The Directorate is directly involved in controlling the operation of fish farms, licensing procedure of alien species or hybrids and is also responsible for the maintenance of fish stocks in natural waters. The concessions for the use of water, which are the prerequisite for setting up a fish farm in Slovenia, are, however, granted by the Ministry of Environment and Spatial Planning. The Directorate manages that part of the state budget which is designed for fisheries and aquaculture. The funds are used for a variety of purposes, including the financing of the setting up and the management of fisheries information systems; financing of performing public service in fisheries by the Fisheries research institute of Slovenia; for the protection of natural resources Development in the Republic of Slovenia 2007-2013; as well as for the collection of data in and monitoring in fisheries. Ecological, biological research and the breeding of some indigenous species (Danube salmon, grayling, nase) are conducted in the Fisheries Research Institute of Slovenia. The Marine Biology Station of the National Institute for Biology deals with interdisciplinary research of the sea.

There has been a dynamic change in the fish production sector due to economic changes in the period from the independence of Slovenia to its accession to the European Union and after the accession. In the future it would be reasonable to support research projects such as: analysis of potential possibilities in fish farming development in Slovenia with regards to spatial and hydrological circumstances and research into the possibility of economic farming of new species. It would also be reasonable to continue with investment in the modernization of older fish farms, especially the improvement of hygienic conditions and the construction of new fish farms which comply with EU legislation technologically and ecologically. It would also be necessary to adopt all outstanding fisheries legislation and encourage the establishment of aquaculture producer organisations with a view to the development of fish farming in terms of small and medium sized family fish husbandry. These measures would facilitate the more competitive position of Slovenian fish farming. Natural circumstances and conservation requirements in Slovenia do not allow the development of large industrial farms. The establishment of producer organisations would make it easier to obtain knowledge, new technology and reduce market costs.

Typical Slovenian maritime enterprise is small family fish/shell farm with self-employed persons, mostly one employee and some unpaid assistance from family workers. Regarding techniques and species all Slovenian marine segments are very homogeneous. Marine fish farming practice is normally intensive and takes place in floating platforms where the cages are submerged into the sea. They produced mostly European seabass. Shellfish farming practice is extensive and takes place in lines of floating buoys linked together, where longlines with mussels are suspended. The major and the only cultured shellfish species is Mediterranean mussel.

Outlook for future production trends

In the Slovenian Operational Programme for 2014-2020 the emphasis is primarily on freshwater aquaculture. The main objectives in marine aquaculture are to increase the production of shellfish to 1000 tonnes and production of marine fish to 120 tonnes. Future development of Slovenian marine aquaculture is strongly conditioned by the small size of the Slovenian Sea. In 2007, three larger areas were designated for marine aquaculture in Slovenian territorial waters that were subsequently separated into 22 plots, for which concessions were granted for the use of marine water in 2009. It is expected that these plots will not be able to expand, due to the use of Slovenian territorial waters for other purposes. All Slovenian maritime fish and shellfish farms are currently operating at about 60% of their capacity. In the future we can expect increasing production to maximum capacity and then stagnation of Slovenian marine aquaculture. The production volume of marine fish and shellfish in 2016 was 27 tonnes and 650 tonnes respectively, so it can be assumed that the objectives of Slovenian OP are realistically achievable.

On the other hand, because of the good quality and quantity of inland water, Slovenia has a good chance to increase freshwater aquaculture, particularly salmonid rearing such as rainbow trout, Huchen (*Hucho hucho*) and brown trout. Today is in Slovenia about 60 trout farms, with a total production of only about 800 tonnes per year.

Fish farming is a sector that promises growth, in particular through an intelligent approach to quality and value adding that is integrated with environmental protection. Main aims of Slovenian OP are Technological development, innovation and knowledge transfer, competitiveness and viability of aquaculture small and medium-sized enterprises (SMEs) including improvement of safety or working conditions, protecting and restoring aquatic biodiversity, enhancing aquaculture-related ecosystems, promoting resource-efficient aquaculture, providing professional training and lifelong learning.

Key objective of Slovenian OP for fresh water aquaculture;

- Increase volume, value and net profit of aquaculture production; in cold water volume to a 1 000 tonnes per year, warm water volume 300 tonnes per year, increased GVA per employee to a €25 000 per year, total value of production to a €1.8 million per year and net profit to a €180 000;
- Increase organic aquaculture and recirculation systems; five fish farms with capacity more than 10 tonnes per year, total production of 500 tonnes per year;
- Support environmental services;
- Create and maintain employment; increase number of total employees to 180.

Slovenia collecting the economic and social data just for the marine aquaculture so in the future will not be able fully assess whether the objectives have been achieved or not.

4.24.6 Data Coverage and Data Quality

Data were collected only for the marine fish species.

Regards to the data base "The central register of aquaculture and commercial ponds" from MAFF, in 2016, there were six operators in Slovenia dealing with shellfish farming and one subject that was engaged in breeding of fish. The data for the operators mentioned were collected from multiple sources (The Agency of the Republic of Slovenia for Public Legal Records and Related Services (AJPES), questionnaire, MAFF)), allowing for cross checking. The accounting data, which are collected by the AJPES public agency, are already checked and verified. The data were collected for all seven subjects.

In June 2017 the questionnaires for 2016 were sent to all operators and all of them also returned the questionnaire. Therefore, the response was 100%.

Economic data on the aquaculture sector were collected from accounting records – AJPES and through questionnaires. The national program for collection of economic data for the aquaculture sector combines information from three main resources:

1. Questionnaire information returned from the aquaculture sector on a voluntary basis,
2. Data base: 'The central register of aquaculture and commercial ponds' from MAFF,
3. The annual accounts of business enterprises.

The data collected from all sources are combined in such a way that a complete set of accounting items is compared for each business enterprise.

In cases where a questionnaire, as the only source, was used the response rate was 100%. In cases where the data from annual accounts of business enterprises was used the response rate was also 100%, because we have economic reports for all investigated companies.

The economic variables were collected on the basis of Council Regulation (EC) No 199/2008 and the Appendix X to the Commission Decision (EC) 949/2008. Slovenia has uploaded the complete set of requested data to the JRC server before the deadline.

While due to confidentiality issues because of the low number of marine fish farms, we are only presenting Mussel rafts segment (seg7.1) in the chapter 4.7.5: ''Main species produced and economic performance by segment''.

In case of Slovenian data, there are differences between Eurostat and DCF data. The difference is because the Eurostat data also contain data from freshwater aquaculture and also because of better coverage of DCF data for marine sector.

List of acronyms and abbreviations;

AJPES - The Agency of the Republic of Slovenia for Public Legal Records and Related Services.

MAFF - The Ministry of Agriculture, Forestry and Food of the Republic of Slovenia.

VARS - Veterinary Administration of the Republic of Slovenia.

Differences in DCF data compared with other official data sources

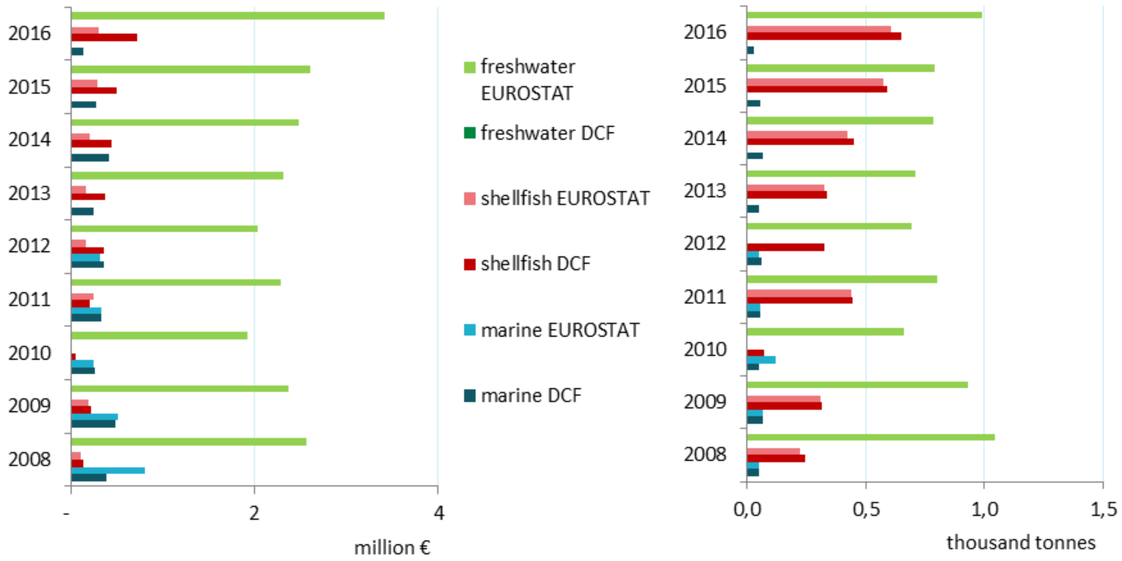


Figure 4.24.10 Comparison of DCF data with EUROSTAT data for Slovenia: 2008-2016

4.25 Spain

4.25.1 Production and sales

In Spain, the production of aquatic products from aquaculture continued the positive trend started in 2013. Despite the slight reduction in the quantities produced in 2016 compared to 2015, the value of production has grown significantly.

The production in aquaculture sector in 2016 was 295 173 tonnes, which means a small decrease compared to 2015, but almost a 10% higher than the average of the 8 previous years. These results suggest the consolidation of the recovery of the industry started in 2014, especially in marine and shellfish productions. The data of production for human consumption from EUROSTAT also shows this positive trend in the period 2008-2016, with an increase in this figure of 13%.

The production in 2016 corresponds mainly to marine aquaculture (fish and shellfish), which together represent more than 90% of the quantities produced, while only 6% is freshwater aquaculture. Besides, marine aquaculture is represented by shellfish and less than 20% of the total production is marine fish. Shellfish production relevance on total production has remained stable around 75% along the period considered. Marine finfish production has followed a positive trend since 2012, mainly due to the recovery of seabream and seabass production, but also due to the increase in other productions such as Atlantic Bluefin tuna, meagre and sole. In the case of freshwater, despite the increase in the quantities produced during 2015 and 2016, its relevance has remained stable since 2014, which confirms the decrease of importance experienced in recent years.

Table 4.25.1 Production and sales for Spain: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/(08-15)
Sales weight (thousand tonnes)	***260.6***	***274.2***	***259.7***	***276.9***	***271.3***	***231.7***	***288.2***	***301.2***	***295.2***	*-2%*	*9%*
Marine	46.2	46.8	43.1	44.9	44.0	46.7	47.8	53.0	53.3	*1%*	*14%*
Shellfish	187.6	203.4	193.9	213.4	207.7	165.8	222.6	228.0	219.8	*-4%*	*8%*
Freshwater	25.7	20.6	20.4	14.3	18.9	17.8	16.4	17.3	18.4	*6%*	*-3%*
Hatcheries & nurseries	1.2	3.4	2.3	4.2	0.7	1.4	1.4	2.8	3.8	*33%*	*73%*
Sales value (million €)	***462.6***	***440.0***	***469.6***	***504.3***	***482.3***	***492.7***	***545.7***	***581.7***	***626.7***	*8%*	*26%*
Marine	253.5	234.2	271.7	281.6	314.6	275.7	330.8	412.0	472.5	*15%*	*59%*
Shellfish	124.1	116.4	111.2	110.8	90.4	106.4	142.7	102.1	82.5	*-19%*	*-27%*
Freshwater	73.4	52.7	45.9	24.0	56.5	88.3	50.1	57.8	62.5	*8%*	*11%*
Hatcheries & nurseries	11.5	36.7	40.8	88.0	20.8	22.3	22.0	9.7	9.2	*-5%*	*-30%*

Source: EU Member States DCF data submission

By far the largest activity in Spanish aquaculture in terms of production is culture of mussel (*Mytilus galloprovincialis*). The 215 907 tonnes obtained in 2016 represented 73% of the total Spanish aquaculture production. In 2016, mussel production decreased 4%. The main species in marine fish production were seabass, seabream and turbot, with 28 614 tonnes, 13 387 tonnes and 7 385 tonnes, respectively. In freshwater production the main species is rainbow trout with 17 590 tonnes produced in 2016, which is more than 95% of this segment output.

The value of the Spanish aquaculture industry has grown continuously since 2012 until almost a turnover of €627 million in 2016, what was an 8% and 26% more compared to 2015 and the average during the 2008-2015 period, respectively, reaching the highest value of the data set since 2008. In recent years, although all the groups have increased the value of their productions, freshwater production has consolidated its loss of importance in the aquaculture industry in Spain.

In shellfish production, and despite the slightly reduction in mussel production, the value has increased during 2015 and 2016, mainly thanks to the improvement in mussel prices. Mediterranean mussel production generated €118 million turnover in 2016, 2% more compared to 2015. Among the shellfish, apart from the commented importance of mussel, there are other species cultivated as oysters, or clams. The main species cultivated in 2016 were Japanese carpet shell (€11.4 million), common edible cockle (€3.8 million) and pullet carpet shell (€3.7 million). Regarding oyster production, European flat oyster (€2.3 million) and Pacific cupped oyster (€2 million) are the main species cultivated. With the exception of the later, all the others increased the value of their productions compared to 2015.

Similarly, the increase in the industry turnover was led by the improvement in marine fish production. The main marine finfish species are seabass and seabream. In 2016, seabass production achieved 28 614 tonnes with a value of €167.7 million; while seabream production was 13 387 tonnes valued €88.6 million. While the production and value of seabream significantly declined in recent years (production in 2013 was 20 thousand tonnes), the production and value of seabass have grown significantly (quantities produced almost double since 2012), in what could be considered a substitution process in the industry, because the same companies usually produce these two species. Turbot production and value have remained stable along the period considered. In 2016, the quantities produced decreased 3% until 7 385 tonnes, but the turnover rise 1% to €61.5 million due to a slightly increase in price. Although Atlantic Bluefin tuna is the fourth species in terms of quantities, due to its greater value, it is ranked as the third most important species in marine fish culture, with a production value of €68 million in 2016. Following the trend started in 2010, tuna production value increased in 2015 27%. Despite a price decrease of 16% in 2015, the largest proportional increase in the quantities produced (50%) facilitated this positive trend. The increase in Atlantic Bluefin tuna captures has increased the supply of this product and as a consequence prices declined. This situation together with a decrease in the quantities produced in 2016, has caused the value generated by this activity to have fallen for the first time since 2013. The management of the fishing quota, together with the development of the fattening of tunas bred in captivity at industrial scale will be the determining factors of the development of this industry. The increase in the value of this group in 2016 has also been caused in part by the rise of other species lees representative in terms of weight but more important in terms of value and in terms of diversification, such as sole (€10.4 million) and meagre (€10.3 million).

Despite the decline in its importance in Spanish aquaculture, the production of the main Spanish freshwater species has followed a positive trend during 2015 and 2016, in terms of both quantities and value. Rainbow trout is the main freshwater species in Spanish aquaculture with a production of 17 590 tonnes in 2016, valued €64.2 million, which were 5% and 7% higher compared to the previous year. The results for 2015 and 2016 seem to confirm a change in trend after a period of high volatility in prices and falls in production. The activity of the hatcheries and nurseries represents less than 2% of the production. Other much less relevant productions are the European eel and sturgeon. The sturgeon has been one of the bets for diversification in freshwater, due to the problems of competitiveness experienced by the trout, but in the last years, the production has stagnated.

4.25.2 Industry structure and employment

The Spanish aquaculture industry accounted 2 990 enterprises in 2016, representing a decrease of 2%, with regard the previous year. Although it is a small decrease, it breaks the flat trend observed in the previous years, which described a somehow stable evolution in the size of the industry in terms of number of operating enterprises.

Small companies bellow five employees registered the largest decrease, falling from 2 462 in 2015 to 2 361 in 2016.

The number of medium size companies has increased, and now this group constitutes 15% in the total structure. Despite of this increase, the small companies segment still concentrates 79% of the total industry. Large companies over 10 employees also decreased by three companies, resulting in a 1% decrease. In contrast, medium size enterprises, between 5 and 10 employees increased 7%, raising the number of companies from 378 to 406. Medium-large companies are in finfish aquaculture.

The total number of employees in the Spanish aquaculture industry was 17 811 in 2016. The figure shows a 1% decrease with regard 2015, and 24% when considering the eight observed years. The long-term decrease in employment is higher than in the number of enterprises. This evolution suggest that the withdrawing companies are more labour intensive and inefficient than the remaining.

The decrease in employment is irregular by gender. Female total employment shows a fall of 11%, counterbalancing 3% increase of male employment. Such a variation in employment according to gender contrasts with the majority of the interannual variations observed since 2008, where most of them indicated increasing female contribution to total employment.

Table 4.25.2 Structure of the Spanish aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/ (08-15)
Structure (number)											
Total enterprises	*3,101*	*3,105*	*3,066*	*3,059*	*3,032*	*3,023*	*3,035*	*3,066*	*2,990*	*-2%*	*-2%*
<=5 employees	2,028	1,976	2,127	1,914	2,269	2,398	2,340	2,462	2,361	*-4%*	*8%*
6-10 employees	714	767	516	370	506	220	234	378	406	*7%*	*-12%*
>10 employees	359	362	423	775	257	405	461	226	223	*-1%*	*-45%*
Employment (number)											
Total employees	*26,322*	*28,882*	*27,907*	*27,180*	*19,891*	*18,805*	*19,914*	*18,077*	*17,811*	*-1%*	*-24%*
Male employees	18,344	20,692	19,852	19,800	13,669	13,914	14,227	12,638	12,969	*3%*	*-22%*
Female employees	7,978	8,190	8,055	7,380	6,222	4,891	5,687	5,438	4,842	*-11%*	*-28%*
FTE	6,612	6,176	6,377	6,639	5,740	5,716	5,946	6,813	6,534	*-4%*	*5%*
Male FTE	5,124	4,852	4,995	4,969	4,400	4,559	4,860	5,150	5,206	*1%*	*7%*
Female FTE	1,488	1,324	1,381	1,665	1,341	1,157	1,089	1,663	1,328	*-20%*	*-4%*
Indicators											
FTE per enterprise	2.1	2.0	2.1	2.2	1.9	1.9	2.0	2.2	2.2	*-1%*	*7%*
Average wage (thousand €)	25.0	17.8	20.9	20.5	22.5	20.8	22.6	19.3	22.4	*16%*	*6%*
Labour productivity (thousand €)	15.2	15.4	28.2	26.8	19.7	24.2	32.9	26.1	36.6	*40%*	*55%*

Source: EU Member States DCF data submission

The evolution of employment in terms of overall FTE shows a higher 4% decrease, suggesting an increase in short term and part time working engagement. Gender differences are important here too. Male FTE remained almost stable with just 1% decrease while female FTE decreased 20%.

FTE per enterprise was 2.2 remaining at the same level as in the previous year. The small value illustrates both the high level of temporary and part time work as well as the relevance of the small scale segment into the National aquaculture industry. Average wage was €22.4 thousand, increasing 16% compared to previous year. Finally, the strong increase in labour productivity confirms the assumption made when observing the evolution of total employment. As the number of companies decreased, labour productivity increased. This is consistent with the idea that the quitting companies are mainly labour intensive and less efficient.

The quotient between total employment and FTE was 2.7 in 2016. Although it has been decreasing along the observed years, it is still suggesting high levels of labour rotation and occupational instability.

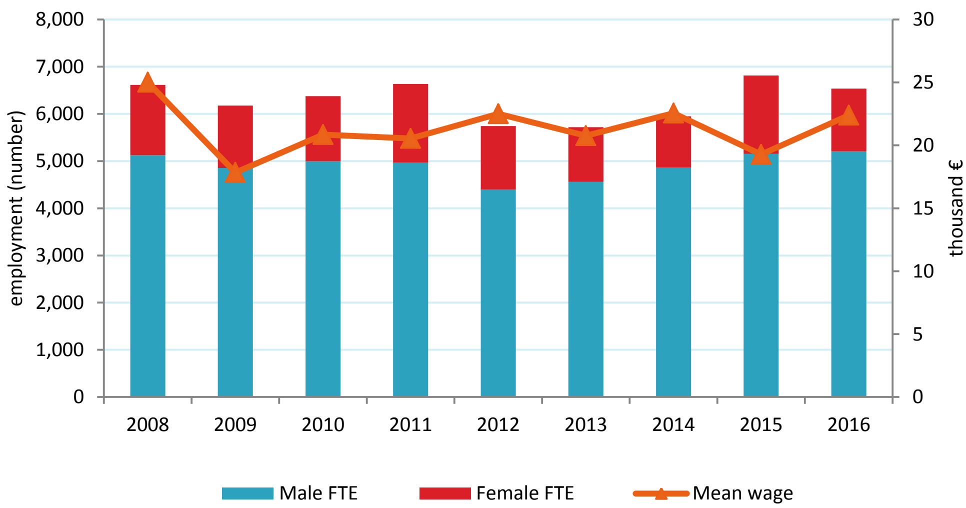


Figure 4.25.1 Employment trends for Spain: 2008-2016.
Source: EU Member States DCF data submission

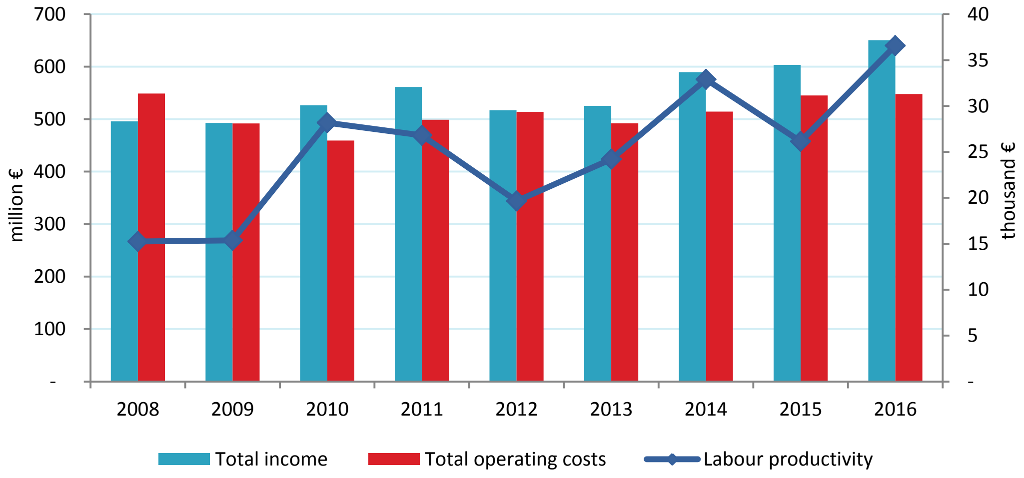


Figure 4.25.2 Income, costs, wages and labour productivity trends for Spain: 2008-2016.
Source: EU Member States DCF data submission

4.25.3 Economic performance

Spanish aquaculture experienced a trend of growth in sales value during 2010 and 2011 after the collapse suffered in 2009. In 2012, the results of the activity of the sector suffered another significant decline. At that time, industry and public institutions that support it, feared that the new reduction in the value of the activity was a new change in trend, and could be the beginning of a new negative evolution of the activity. However, the improvement of the results during the period 2013-2016, confirmed that 2012 was a single result, and that the trend in the medium-long term for the Spanish industry is positive.

The turnover of the Spanish aquaculture industry in 2016 increased 8% and 30% compared to 2015 and 2012, respectively. More than 96% of the Spanish aquaculture income comes from sales turnover during 2015 and 2016, which represents and increase compared to previous years.

On the contrary, although other incomes increased 36% in 2016 compared to 2015, the long-term perspective shows that the €13.8 million of other income obtained from other activities different from aquaculture were 46% less than the average of the previous years, and less than the half compared to the €30.2 million generated in 2014. The improvement in the incomes obtained from the main activity of the aquaculture companies, can be an explanation for the decrease in incomes from other activities.

The subsidies received by the Spanish aquaculture industry in 2016 were 37% less compared to the average of previous years. The dependence of Spanish aquaculture incomes on subsidies is low. In 2016, the amount of subsidies was less than half of those in 2011 and represented less than 2% of total incomes. The explanation for the reduction is not a reduction in availability of European funds. The annual report of execution of the 2017 EMFF in Spain[14], indicates as main reasons for the lack of execution of part of the funds both the lack of compliance of the requirements by the applicants, and a lack of interest of the sector. The explanation in part of this last assertion can be found in the satisfaction survey of the EMFF, presented by the Spanish program's monitoring committee in July 2017[15], which highlights in its conclusions that although the beneficiaries value the program positively, they consider administrative procedures and compliance conditions complex. The slowness in the implantation of the FEMP is another of the aspects indicated in the survey. In this context, it is necessary to highlight that the period 2014-2016 coincides with the launching of the new FEMP. Another explanation can be found in the

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[14] Informe Anual de Seguimiento. IV Comité de seguimiento 24-04-2018. Ministerio de Agricultura, Pesca y Alimentación. España.

[15] Encuesta de satisfacción FEMP 2014-2020. III Comité de seguimiento 05-07-2017. Ministerio de Agricultura, Pesca y Alimentación. España.

improvement of the economic results of the industry. After an increase in subsidies from 2008 to 2012, coinciding with the years of greatest instability in the industry, subsidies have followed a downward trend, which can be understood as one more indicator of the improvement of competitiveness and the economic performance experimented by the industry since 2014.

Table 4.25.3 Economic performance of the Spanish aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	*% of total income*	Change 2016-15	Development 2016/(2008-15)
Income (million €)												
Turnover	462.6	440.0	469.6	504.3	482.3	492.7	545.7	581.7	626.7	*96%*	*8%*	*26%*
Other income	21.7	36.4	36.3	36.2	15.1	19.3	30.2	10.1	13.8	*2%*	*36%*	*-46%*
Subsidies	11.4	16.3	20.5	20.7	19.7	13.3	13.6	11.3	10.0	*2%*	*-12%*	*-37%*
Total income	*495.8*	*492.8*	*526.4*	*561.2*	*517.1*	*525.2*	*589.5*	*603.1*	*650.4*	*100%*	*8%*	*21%*
Expenditures (million €)												
Wages and salaries	97.4	87.3	94.1	99.3	94.4	83.6	92.8	91.1	107.7	*17%*	*18%*	*16%*
Imputed value of unpaid labour	67.9	22.9	38.9	37.0	34.8	35.0	41.3	40.2	38.5	*6%*	*-4%*	*-3%*
Energy costs	13.3	23.2	22.6	27.1	24.4	18.8	21.6	20.7	23.0	*4%*	*11%*	*7%*
Repair and maintenance	13.6	16.1	15.6	13.9	12.9	12.3	13.2	11.8	13.4	*2%*	*13%*	*-2%*
Raw material: Feed costs	96.8	117.4	110.5	123.2	143.7	162.4	158.2	186.7	166.3	*26%*	*-11%*	*21%*
Raw material: Livestock costs	152.9	115.4	65.1	82.3	83.9	57.7	57.3	60.2	66.8	*10%*	*11%*	*-21%*
Other operational costs	106.9	109.4	112.5	116.0	119.7	122.4	130.0	134.4	132.2	*20%*	*-2%*	*11%*
Total operating costs	*548.9*	*491.7*	*459.2*	*498.9*	*513.8*	*492.2*	*514.4*	*545.0*	*547.8*	*84%*	*1%*	*8%*
Capital Costs (million €)												
Depreciation of capital	12.7	43.0	40.9	40.4	34.1	24.7	31.9	25.7	28.6	*4%*	*11%*	*-10%*
Financial costs, net	-23.7	-18.4	-16.8	-17.1	-16.6	-12.2	-11.7	-12.1	13.5	*2%*	*211%*	*184%*
Extraordinary costs, net	15.4	-2.3	4.8	2.3	0.7	-0.4	2.6	1.2	0.0	*0%*	*-103%*	*-101%*
Capital Value (million €)												
Total value of assets	958.5	724.7	854.6	736.7	907.0	916.8	798.5	760.9	688.4	*106%*	*-10%*	*-17%*
Net Investments	42.4	26.3	11.7	27.7	16.7	56.7	22.5	12.5	24.5	*4%*	*96%*	*-9%*
Debt	469.8	441.4	476.6	358.5	429.3	432.2	333.5	316.8	342.4	*53%*	*8%*	*-16%*
Input & Production (thousand tonnes)												
Raw material: Feed	154.2	127.3	122.3	166.1	174.9	180.7	181.6	154.7	123.0		*-20%*	*-22%*
Raw material: Livestock	16.9	14.7	15.0	26.0	24.3	21.1	44.5	25.3	23.0		*-9%*	*-2%*
Performance Indicators(million €)												
Gross Value Added	100.8	94.9	179.7	178.0	112.8	138.4	195.6	178.1	238.9	*37%*	*34%*	*62%*
Operating cash flow	-53.1	1.1	67.1	62.3	3.3	33.0	75.1	58.1	102.6	*16%*	*76%*	*232%*
Earning before interest and tax	-65.7	-41.9	26.2	21.9	-30.8	8.3	43.2	32.5	74.0	*11%*	*128%*	*9574%*
Net profit	-42.0	-23.5	43.0	39.0	-14.2	20.5	54.9	44.6	60.5	*9%*	*36%*	*296%*
Capital productivity (%)	10.5	13.1	21.0	24.2	12.4	15.1	24.5	23.4	34.7		*48%*	*92%*
Return on Investment (%)	-6.9	-5.8	3.1	3.0	-3.4	0.9	5.4	4.3	10.8		*152%*	*#######*
Future Expectation Indicator (%)	3.1	-2.3	-3.4	-1.7	-1.9	3.5	-1.2	-1.7	-0.6		*66%*	*17%*

Source: EU Member States DCF data submission

Operational costs show particular structures across species, but at the aggregated level, four factors represent the 86% of the total operational expenditures in 2016; wages and salaries, feed cost, livestock cost and other operational cost.

Labour cost represents 20% of the operational cost in 2016 and, after a decrease in 2015, it has increased again 18% after two years of relative stability. When it is considered the imputed value of the unpaid labour, the labour cost increase until represent the 27% of the operational cost. The rise in labour cost in 2016 is not caused by an increase in the number of employees (the level of employment in the sector decreased compared with 2015 as it is shown in The Spanish aquaculture industry accounted 2 990 enterprises in 2016, representing a decrease of 2%, with regard the previous year. Although it is a small decrease, it breaks the flat trend observed in the previous years, which described a somehow stable evolution in the size of the industry in terms of number of operating enterprises.

Small companies bellow five employees registered the largest decrease, falling from 2 462 in 2015 to 2 361 in 2016.

The number of medium size companies has increased, and now this group constitutes 15% in the total structure. Despite of this increase, the small companies segment still concentrates 79% of the total industry. Large companies over 10 employees also decreased by three companies, resulting in a 1% decrease. In contrast, medium size enterprises, between 5 and 10 employees increased 7%, raising the number of companies from 378 to 406. Medium-large companies are in finfish aquaculture.

The total number of employees in the Spanish aquaculture industry was 17 811 in 2016. The figure shows a 1% decrease with regard 2015, and 24% when considering the eight observed years. The long-term decrease in employment is higher than in the number of enterprises. This evolution suggest that the withdrawing companies are more labour intensive and inefficient than the remaining.

The decrease in employment is irregular by gender. Female total employment shows a fall of 11%, counterbalancing 3% increase of male employment. Such a variation in employment according to gender contrasts with the majority of the interannual variations observed since 2008, where most of them indicated increasing female contribution to total employment.

Table 4.25.2), but for a recovery of the average wage. The increase in the average wage, together with the increase in labour productivity may be the result of an increase in the technological level of the industry and in the professionalization and qualification of the sector labour force. This change in the labour force structure is coherent with the changes in the industry structure, where the relevance of intensive productions (that require less employment but more qualified and less seasonal) is gaining importance to the detriments of extensively and semi-intensively aquaculture activities.

Livestock cost represented in 2016 the 12% of the operational cost in the aquaculture industry. After a strong decline in 2013, this cost has followed an increasing trend in the period 2014-2016. The reduction in the livestock quantities supplied to the industry in 2016 (9%) compared with the rise in the cost (11%) indicates an increase in the average price of the livestock purchased during 2016.

The main cost in the Spanish aquaculture industry is the feed, which represents 30% of total expenditures. Feed cost in 2016 decreased 11% compared to 2015, but it was still 21% higher than in the average of previous years considered. The comparison between the evolution of the feed quantity consumed and its cost shows a new rise in the average feed price during 2015 and 2016. The widespread increase in the cost of raw materials used in the manufacture of feed for aquaculture has led to an increase in its price in recent years. This positive trend registered throughout the period under consideration has recently been accentuated. The average price of feed in 2016 was 55% higher than in 2014. The continuous grow in the price of such an important operational cost is a constant concern of aquaculture producers. It has been observed that in some industries, such as seabream and seabass, the increase in feed prices has been able to limit the positive impact on the economic performance indicators of the technical, management and market improvements and innovations undertaken by the sector in recent years. The increase in the price of feed makes it even more relevant to the future competitiveness of the industry to improve the efficiency in the use of feed. In this sense, the European Commission is aware of the strategic importance of this problem, and supports the aquaculture industry through various research projects that have, among other objectives, the development and improvement of aquaculture feed. In the case of Spain, the MedAID[16] project is an example of the research

[16] Mediterranean Aquaculture Integrated Development (MedAID). Funded by the European Commission (H2020 GA 727315).

efforts that are currently being carried out, not only in Spain, but throughout the Mediterranean seabream and seabass aquaculture industry.

Capital costs include net financial costs, depreciations, and extraordinary costs. Net financial costs increased 11% in 2016[17], continuing the trend started in 2014. The explanation for the increase in amount of financial costs relies more on the increase in the total debt of the Spanish aquaculture industry than in a rise in interest rates and cost. It is difficult to draw a single cause but, but the positive economic returns during 2014 and 2015 help to reduce the debt of the companies. By 2016, the increase in the total debt seems to be more in line with the context in which the positive economic results obtained from 2012 has encouraged new investments and as a consequence the need for external capital to finance part of these new assets. Depreciation of capital has increased 11% in 2016 compared with 2015. This also suggest that aquaculture firms have renewed their fixed equipment's with the improved returns obtained during 2014 and 2015. Regarding extraordinary cost, available data do not allow to provide a properly explanation of their origin. However, the particular nature of these cost, associate with circumstances that are not related with the normal activity of the company, helps to explain the absence of a clear trend during the period analysed.

After a negative evolution in all the economic performance indicators in 2012, Spanish aquaculture has followed a positive trend from 2013 to 2016. It is true than the performance indicators worsened in 2015 compared to 2014 (mainly due to the increase in industry feed costs), but then again improved significantly in 2016. Undoubtedly, 2016 has been the year in which the Spanish industry has obtained the best economic performance results of the entire time series considered. These positive results clearly indicate that the improvement has not only consisted in a new increase in production, but that the efforts made by the companies in terms of investments and innovation have allowed obtaining the best economic results in recent years. The contribution of the sector to the economy was €239 million in 2016, which represented the 37% of the total income and an increase of the 34% respect to 2015 and a 61% more than the average of previous years.

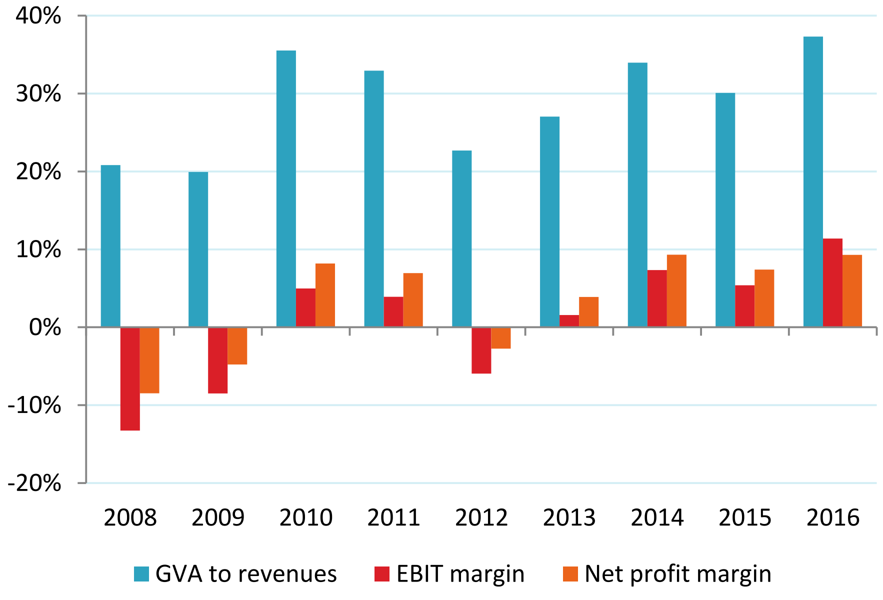

Figure 4.25.3 Economic performance for Spain: 2008-2016.
Source: EU Member States DCF data submission

[17] Note that "Financial cost net" should be calculated as costs, coming from financial activity of the enterprise, minus the financial income. In the case of the Spanish chapter, the negative value of this indicator during the period 2008-2015 seems to be caused not by a greater amount of financial income than financial cost in the industry, but by a different calculation. This seems to have been corrected in 2016. However, this limitation affects the result of the calculation of "net profit" between 2008 and 2015, and the analysis of the evolution of net profit in 2016 with respect to previous periods. This circumstance has been taken into account in the analysis carried out.

The most relevant indicators for analysing the performance of a company or industry are EBIT and net profit. It can be seen that EBIT represented in 2016 11% of the total income and between 2015 and 2016 increased 128%. This significant evolution was possible due to a higher proportional increase in the total income (8%) than in the total operating cost (that decreased 2%). There are significant differences by segments, but at aggregated level, in terms of incomes, the positive evolution of the turnover was not caused by an increase in the industry production volume, but this time by an increase of 10% in the average value of the quantities produced. There are several possible drivers of this increase in value: on the one hand the positive evolution in the price of some species in recent years; on the other, the increase in the importance of higher value species such as the case of seabass; likewise, the increase in exports to markets in which the product has a greater value. Similarly, the average operating cost per kilogram increased 3% in 2016, what is proportionally less that the incomes. In general, the different operational costs have increased, but the reduction in the total feed cost due to the lower use of feed during 2016 facilitate the total operational cost to remain stable compared to 2015. Finally, Net profit, what represents the final performance of the capital, has followed the same trend than GVA and EBIT, an in 2016 achieved a value of more than €60 million, what was three times more than in 2015.

When considering a relative measurement as is the Return on Investment ratio, it is confirmed an increase from a rate of 4.3% in 2014 to 10.8% in 2016. That means than in average during 2016 the economic performance of the assets of the Spanish companies have been positive, or in other words, for each €100 of investment made in the companies, were obtained €10.8. Considering this, and regardless of how the activity was funded and what was the financial cost, the activities developed by the Spanish aquaculture industry were profitable. During the period 2014-2016, the industry not only obtained positive economic returns, but they grew over time.

The comments about the performance indicators can be summarized in a positive trend and evolution in the middle term, which has intensified in the last years considered. The good economic results provide financial stability to the sector companies and reduce financial risk. These results generated a positive outlook, and it is expected than after a period of economic crisis, demand contractions and price volatility, the industry can now take advantage of this new positive scenario to consolidate improvements in production efficiency, product and market and commercialization. Thus, the industry would continue the increase the efficiency, competitiveness and sustainability of the economic activities.

4.25.4 Main species produced and economic performance by segment

The four main species in Spanish aquaculture in terms of value (European seabass, Mediterranean mussel, Gilthead seabream and Atlantic Bluefin tuna) represented 93% and 71% of the total industry quantities and value in 2016, respectively.

By far Mediterranean mussel goes on been the main harvested species in Spain, with a production in 2016 of 215 907 tonnes, which represent nearly three of each four kilograms of total production. It is mainly produced in Galicia in rafts, but it is also cultivated in Cataluña, and in a smaller proportion in Valencia and Baleares in rafts, and in Andalucía in longlines. Also, it is important to mention that the value of mussel production represented less than 20% of the total industry. Mussel is a species which production depends on the environmental conditions, suffering big fluctuations into different years in the past. However, since 2014 both the value generated by mussel industry has been increasing due to both, and increase in the quantities, and the rise of prices.

When talking about marine fish, seabass is the main harvested species in Spain, with 28 614 tonnes in 2016, with a total value of €167 733 thousand. Seabream is the second marine fish cultivated in Spain, with 13 387 tonnes in 2016, valued €88 615 million. These two species represented more than 40% of the total industry production value in 2016. Seabream and seabass production is concentrated in Mediterranean coast, but also are produced in the Canary Islands and in the Atlantic coast of Andalucía. The third important species in turbot produced in the North Atlantic coast and with a total production in 2016 of 7 385 tonnes with a value of near €61.5 million. The Atlantic Bluefin tuna, with only nearly 4 562 tonnes (less than 2% of the total industry production volume), gets a turnover of nearly €68 million, what was equivalent to 11% of total production value.

The rainbow trout is the main freshwater species in Spain. Its production takes place inland around mostly all the regions of the country. Total production achieved 17 590 tonnes in 2016 with a value of €64 235 thousand.

In the group of molluscs in Spain there is also a traditional ways of aquaculture, like the clams cultivated in the intertidal areas. Their production is dominated by *Ruditapes philippinarum*. These are a kind of aquaculture with a high social value in the areas which it is concentrated.

Analyse of evolution of the average prices for the main species in Spanish aquaculture indicates different evolutions according to the different main species. Seabream continued with the positive trend started in 2014 until achieve an average price of €6.62 per kg in 2016, the highest record in the period considered. In the case of seabass prices, 2016 was a change in the decreasing evolution followed between 2012 and 2015. The production of seabream has significantly declined in recent years, what explains the rise in prices, while in the case of seabass the negative evolution of the price until 2015 was caused by the higher productions. Furthermore, other factors may have influenced in price behaviour e.g. exports of high value production to other European markets such as France or Italy, as well as the positive results of commercial and differentiation actions such as the collective brand "*Crianza de nuestros mares*" promoted by the Spanish association of producers APROMAR. Trout prices have followed a growing trend since 2013. The average price in 2016 was 17% higher than the average of previous years. In the case of the mussel, prices have remained relatively stable, although during 2015 and 2016 they have continued to grow slightly. The most significant aspect in the evolution of prices is the fall experienced by the price of Atlantic Bluefin tuna. In 2015, the fishing quota for this species increased by 20%, which increased the supply to the markets, and caused the fall in the price of aquaculture tuna.

Figure 4.25.4 Main species in terms of weight and value in Spanish production: 2016.
Source: EU Member States DCF data submission

The most relevant segments in the Spanish aquaculture are analysed below: Seabream & seabass in cages, other marine fish cages, mussel rafts and trout combined. There is a segment that reports a higher value than trout combined, which is other marine fish combine. In this segment, besides the turbot and the sole, the data of the companies that work in brackish waters in Andalusia are included. It is a multispecies production, from prawns to seabream and other finfish species. The decision to assign a company to a specific segment is according to the species that has greater production, but includes all the production. With the information available, the productions included in this segment cannot be analysed. Based on these limitations, it has been decided to analyse the trout combine production, which is the main segment in freshwater.

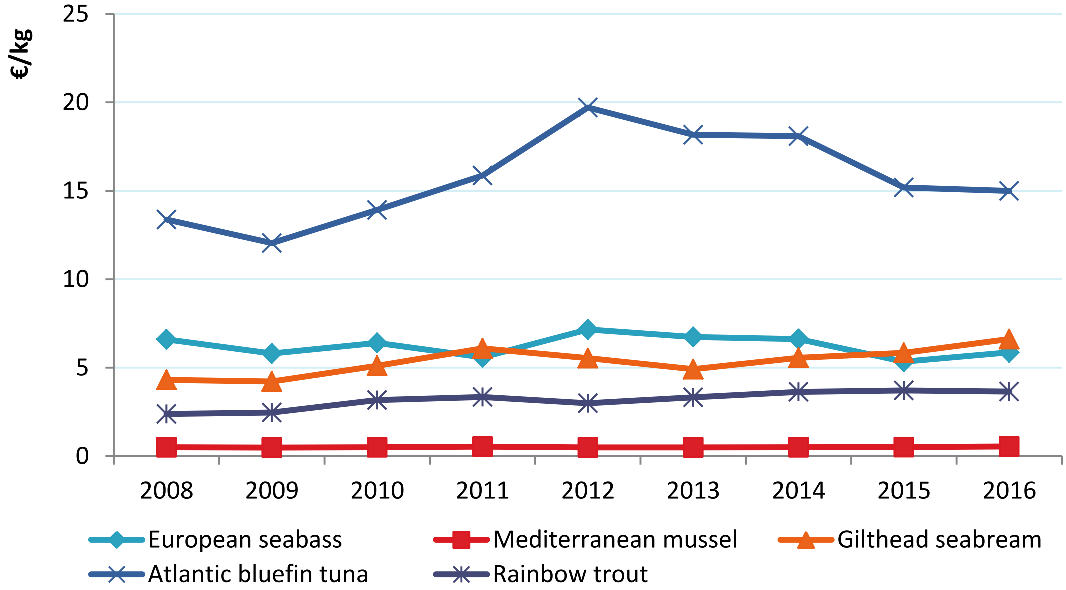

Figure 4.25.5 Average prices for the main species produced in Spain: 2008-2016.
Source: EU Member States DCF data submission

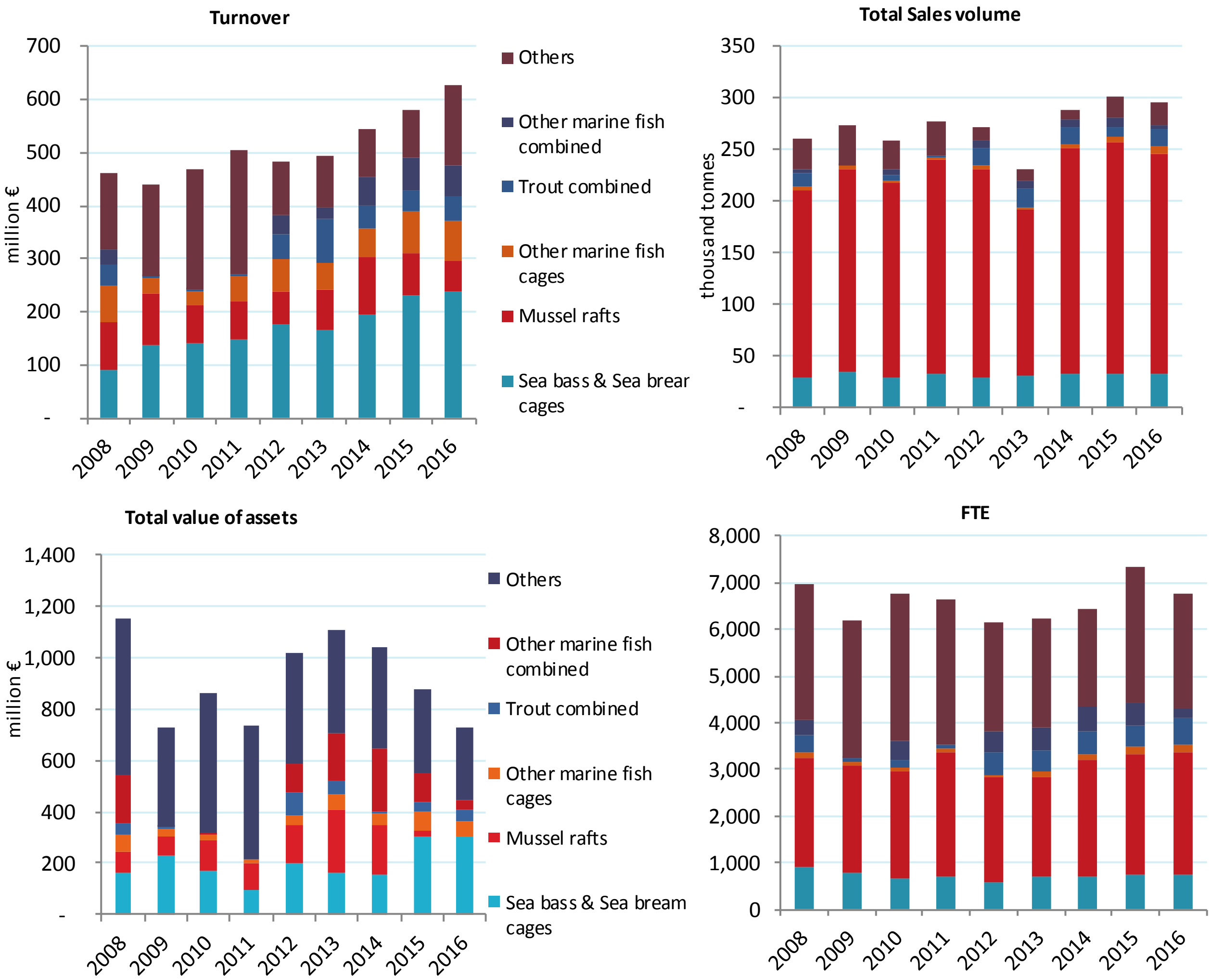

Figure 4.25.6 Structural development of the Spanish aquaculture sector: 2008-2016.
Source: EU Member States DCF data submission

Table 4.25.4 Economic performance of main Spanish aquaculture segments: 2008-2016 (million €).

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	% of total income	Change 2016/15	Development 2016/(2008-15)
Sea bass & Sea bream cages												
Total income	105.4	157.6	159.1	165.8	188.9	178.6	221.7	235.6	249.9	100%	6%	42%
Gross Value Added	-13.2	5.5	23.2	15.2	12.2	-0.9	30.5	34.6	60.2	24%	74%	349%
Operating cash flow	-32.0	-17.1	3.6	-1.2	-3.6	-16.0	7.9	14.6	34.0	14%	133%	720%
Earning before interest and tax	-35.5	-30.7	-7.6	-11.1	-14.2	-24.6	-1.0	6.3	26.2	10%	319%	277%
Net profit	-29.6	-24.0	-1.5	-5.8	-8.4	-20.3	2.9	10.3	3.4	1%	-67%	136%
Total sales volume (thousand tonnes)	29.7	34.1	29.8	32.2	29.4	31.4	33.0	32.4	32.9		2%	4%
Other marine fish cages												
Total income	68.6	29.2	25.3	45.5	59.5	50.5	57.9	82.5	79.4	100%	-4%	51%
Gross Value Added	28.3	11.0	7.0	22.2	14.4	16.6	20.5	33.7	40.4	51%	20%	110%
Operating cash flow	23.5	8.5	3.9	17.4	7.8	9.7	14.3	26.0	31.2	39%	20%	125%
Earning before interest and tax	22.1	7.7	2.9	16.3	6.3	8.3	12.7	24.3	28.2	36%	16%	124%
Net profit	24.2	7.9	3.7	18.4	10.2	10.2	15.1	27.5	28.9	36%	5%	98%
Total sales volume (thousand tonnes)	3.8	2.4	1.8	2.9	3.0	2.9	3.1	6.3	6.2		-1%	91%
Mussel rafts												
Total income	94.0	106.4	83.2	81.6	64.6	78.6	110.1	81.8	56.3	100%	-31%	-36%
Gross Value Added	32.4	67.2	52.3	57.8	45.4	54.7	81.0	59.4	42.8	76%	-28%	-24%
Operating cash flow	-36.1	45.8	27.9	28.5	18.6	17.0	36.2	14.6	6.4	11%	-56%	-66%
Earning before interest and tax	-37.1	40.5	21.2	24.2	16.9	14.7	34.4	12.4	4.4	8%	-64%	-72%
Net profit	-34.2	43.3	23.7	23.8	16.7	15.3	34.7	12.8	4.5	8%	-65%	-73%
Total sales volume (thousand tonnes)	180.6	197.8	188.4	208.0	202.1	160.6	219.6	224.0	214.0		-4%	8%
Trout combined												
Total income	38.7	2.5	3.2	2.2	50.6	84.3	42.9	41.2	44.7	79%	9%	35%
Gross Value Added	12.6	0.9	0.9	0.9	7.2	25.4	12.8	10.0	10.9	19%	9%	23%
Operating cash flow	2.9	0.5	0.3	0.5	-3.5	11.1	4.6	0.8	0.5	1%	-36%	-77%
Earning before interest and tax	2.6	0.3	0.1	0.5	-6.9	7.6	3.4	-0.9	-1.3	-2%	-34%	-251%
Net profit	3.3	0.4	0.2	0.5	-6.6	8.0	3.7	-0.6	-0.9	-2%	-63%	-182%
Total sales volume (thousand tonnes)	12.9	1.3	5.1	0.5	17.7	17.2	15.6	10.0	16.7		67%	67%

Source: EU Member States DCF data submission

Segment 1: Seabass & Seabream cages

Seabass (*Dicentrarchus labrax*) and seabream (*Sparus aurata*) are the most important species in finfish aquaculture in Spain in volume of production and the most important species in whole industry in terms of value. Seabass production has followed a positive trend in recent years, both in terms of quantities and value. In 2016, seabass production achieved 28 614 tonnes (20% and 84% more compared to 2015 and the average production in previous years, respectively) with a value of €167.7 million (that was 32% and 74% higher compared to 2015 and the averaged of the value achieved during the period 2008-2015). Traditionally, seabream use to be the most important of the two species, but the positive evolution of seabass has ranked this species as the most valuable species of the Spanish aquaculture industry. Meanwhile, seabream production in 2016 was 13 387 tonnes valued €88.6 million, that is, a reduction of 31% and 11% in sales weight and turnover, respectively, compared the average of previous years.

These species are cultivated in warm waters, in the Mediterranean Sea, but also in the Spanish Atlantic coast and Canary Islands. There are productions in Andalucía, Islas Canarias, Valencia, Murcia, Islas Baleares and Cataluña. Seabass most important productions are located in Murcia, Andalucía and Canarias, while the most important region for seabream is Valencia. Along the Mediterranean Spanish coast, there are hatcheries that cultivate the fingerlings, which later will be grown in cages in the sea. Seabass most important fingerlings productions take place in Baleares, Andalucía and Valencia, while in the case of seabream Valencia is the main area, followed by Baleares, Andalucía and Murcia. In the case of seabream fingerlings there also a small production in Cantabria, a region located in the Atlantic north coast. In spite of these establishments, there are not enough juveniles for the companies, which grow these species in cages; so they must be imported from other countries.

Although a part from some production developed in brackish waters in southern Spain, the majority of the domestic seabass and seabream production is grown in cages. The production in cages generated 32 879 tonnes, valued almost €239 million in 2016. These results represented the 78% of the total seabream and seabass production volume and value. In fact, this segment production represented only the 11% of the total production volume at the Spanish aquaculture industry, but generated 38% of the total turnover in 2016. Apart from production in cages, there are other systems such as brackish waters (10% of the turnover), combined (8.6% of turnover) and hatcheries and nurseries (3% of the turnover).

The number of companies has gone on the reduction process since 2008, from 59 firms to 26 in 2016, but the average size of the companies has grown. Small (less than five employees) and large companies (more than 10 employees) represented in 2008 40% and 47% of the cage segment structure, respectively. By 2016, small companies were only the 8%, while large companies were more than the 81%. These companies represent less than 1% of production units in the Spanish aquaculture industry, but provide almost four of every ten euros. They are intensive production companies, in which the labour productivity in 2016 was 120% higher than in the average of the Spanish industry.

The number of employees in this segment suffered a decline in 2012, but it recovered later and in 2016, increased 12% to 976 compared to 2015. Despite the recovery, the people hired in this segment were 2% less than the average of the previous years. On the contrary, the number of FTEs decreased 1% in 2016 compared to 2015, but the analysis in the medium term shows a positive trend since 2012.

The evolution shows an improvement in the employment situation during the period considered, particularly since 2012. The number of employees and FTEs increase, the last proportionally more, what indicates better employment stability. The number of FTE per enterprise increased and in 2016 was almost 50% higher than the average of previous years. This is another indicator of the process of concentration that has been taken place in this industry in recent years, particularly in cage segment. Furthermore, labour productivity in seabream and seabass farming in cages improved in recent years. This positive evolution was significant in 2016, when it grew a 72% compared to 2015. Costs on wages and salaries increased in 2016, consolidating the positive trend started after 2013. Average wage was €39.4 thousand in 2016, what was 23% higher than the average of previous years and the higher figure in the period considered. Female employment has increased but it still remains below 15% of the total.

Seabream and seabass cages segments incomes has followed a positive trend during all the period considered, different from the economic performance of the activity. After several years with some indicators, which showed bad economic results, the economic performance began to recover in 2013 and this recovery has gone on during the period 2014-2016. GVA increased from €35 million in 2015 to €60 million in 2016. In the same way, the EBITDA (that is, the profits of the activity without considering financial cost and tax) grew from €6 million to €26 million between 2015 and 2016. This is particularly significant since between 2008 and 2014, the profitability of this production segment was negative.

The greater proportional increase in incomes than in costs has facilitated the improvement in economic performance indicators. During 2015 and 2016, the supply of seabream and seabass in the international markets grew, but the increase in demand allowed prices to remain stable. In the particular case of Spain, the greater proportion of seabass, the more valuable species, together with the increase in the price of seabream, as its supply decreased, explain the improvement in incomes.

In the structure of operating expenses is the feed that remains a highest percentage, although its price, which was increasing in recent years, seems to have been contained in the last year. The feed cost in the seabass and seabream cage segment in Spain decreased from 50% of the total operating cost in 2015 to 40% of the total in 2016. The decrease in feed relevance in the cost structure is the result of a reduction in feed cost caused by a significant reduction in the quantities of feed purchased. Livestock purchases together with feed represented in 2016 almost 62% of total operational cost. Livestock purchases remained stable but due to an increase in the average price, fingerlings cost increased. The second most relevant cost is other operational cost that remained stable in recent years. The relevance of this type of cost is more significant in cage segment, since larger companies normally develop more activities related with external services, consultancy, marketing, etc. Finally, due to the improvements in employment and wages, the relevance of labour cost in the operational cost structure increased from 10% to 14% between 2015 and 2016.

Figure 4.25.7 Economic performance indicators for the main Spanish segments: 2008-2016.
Source: EU Member States DCF data submission

Segment 2: Other marine fish in cages

Atlantic Bluefin tuna is the most relevant species in this segment. Final production marketed surpassed 6 200 tonnes in 2015 and 2016, which means an increase over 100% regarding 2014. Such an increase has been possible due to the improvement in the stock which allowed increasing catches of juveniles to be used as livestock in the fattening facilities. The rise in production has allowed a decrease in the prices of the final product stimulating demand.

Employment increased 8.7% in absolute terms, raising to 219 people in 2015 and 239 in 2016, and in FTE reaching around 190 in the last two years. The ratio between these two magnitudes shows the lowest labour rotation rate in all Spanish aquaculture, suggesting higher qualification of workers.

The activity resulted in a total turnover of over €77.3 million in 2016 from a value of assets of €63.7 million. These figures mean 38% increase in total turnover in the period from 2014 to 2016. The resulting total income was €79.3 million in 2016, increasing 37% since 2014. In general, performance indicators show a significant improvement in the industry. On the other side, total operating costs increased only 10%, allowing positive results and higher benefits. GVA increased 44% and EBIT 92% from 2014 to 2016. On regard cost structure, feed and livestock costs represent 28% and 5% of total costs respectively, which is comparable to the structure observed in previous years.

Segment 3: Mussel rafts

The mussel industry in Spain, most of it concentrated in Galicia, represented the 73% of the total Spanish aquaculture production in terms of quantities and the 18.8% of the value in 2016, considering that the average price of this product is significantly lower than the main fish cultivated in Spain. Being a species, which depends on natural conditions, its annual production might reflect high fluctuations over time; in 2016 suffered a decrease of 4.3% respect to 2015 until 215 thousand tonnes. This total production was the third highest peak in the period considered. The evolution during 2015 and 2016 illustrates how dependent is the mussel production to the environmental conditions in the Galician estuaries, where red tides can close the production areas for long periods of time. The production value of this segment was €118 million in 2016, the highest production value during whole period analysed; which represents an increase of 2.4% compared to 2015. This increase is mainly explained due to the growth of prices in 2016 (€0.55/kg), the highest observed price since 2008.

This is the biggest segment in terms of employment, with 2 610 FTE in 2016, which was 1.5% higher than in 2015; and it also the highest number of people employed in the segment during the period. Traditionally it is a sector where there are a lot of people working a part of the year; most of them are self-employed workers; so the small familiar units are the base of this segment.

In this context, and as in 2015, the mussel industry was the most profitable of the three segments analysed during 2016. The mussel industry GVA was positive in all the years analysed and the EBIT and net profit have been positive since 2009. Although all the economic indicators have a positive value it is necessary to highlight the break in the negative evolution of the indicators between 2011 and 2013 and the positive evolution in all of them in 2016. Key economic indicators of this segment show a decrease of the value of production (2.9%) between 2015-2016, instead of an increase of prices (from 0.43 €/kg. In 2015 compared to 0.46 €/kg in 2016)[18].

The operational cost structure of this extensive aquaculture activity really differs from the observed in the other segment analysed. Different from fish farming where feed is the main cost and labour cost is under the 27% of the total cost, in the case of the mussel industry there is no feed cost, but as a low investment capital activity, labour cost is the most relevant operational cost. The relevance of labour cost is confirmed in the Figure 4.3.8 in which can be observed that the wages and salaries represented the 18% of the operational cost, but what is more relevant, the imputed value of unpaid labour was the 52% of the total operational cost.

[18] Xunta de Galicia (2016) Aquaculture Yearbook. Available online at http://www.pescadegalicia.gal/Publicaciones/AnuarioAcuicultura2016/indice.html

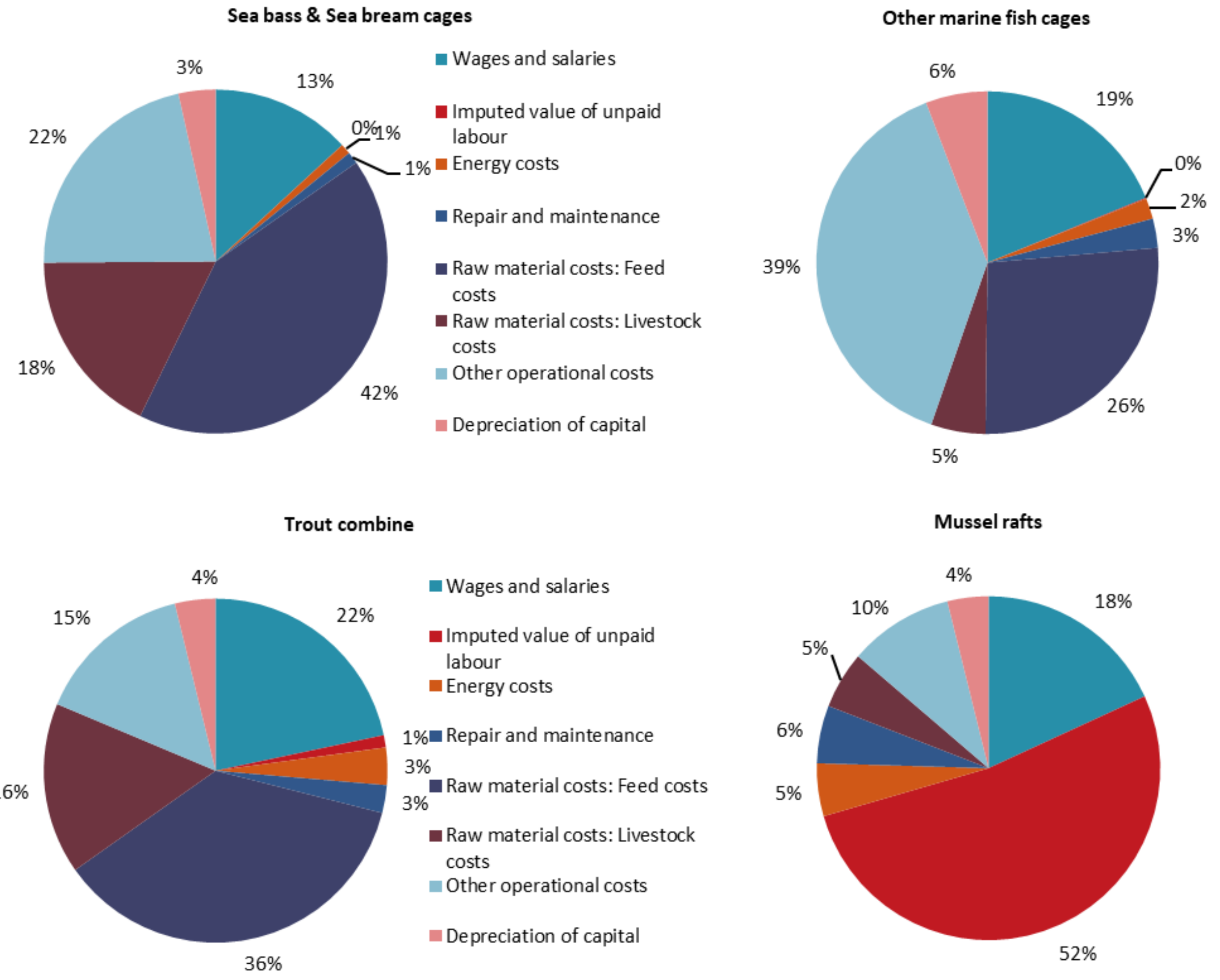

Figure 4.25.8 Cost structure of the main segments in Spain: 2016.
Source: EU Member States DCF data submission

Segment 4: Trout combine

This segment represents the freshwater aquaculture in Spain, with the rainbow trout (*Oncorhynchus mykiss)* as nearly the only cultivated species, except for minor productions of eel and sturgeon. There are establishments dedicated to this species in nearly all the Spanish regions: hatcheries, nurseries and farms to grow fries. Rainbow trout is cultivated in inland establishments, situated in the bank of rivers and which take advantage of the natural river flow.

The big differences in the figures of this segment along the years must be interpreted as a change of some companies into different segments, depending on the culture phases and the culture species. The companies which cultivate sturgeon and trout have been included in this segment because the value of trout production is higher than the sturgeon value for these specific companies.

Rainbow trout production is suffering a steady decline since 2008, with less companies and establishments dedicated to this activity, but it must be noted a new increase in the quantities produced in the last three years considered. In 2016, there were 75 companies dedicated to this activity, mainly small companies with less than 5 employees, but the number of large companies increased from 12 in 2015 to 19 in 2016. The number of FTE in this segment represents 8% in Spanish aquaculture. Employment has fluctuated during the period considered, but in recent years increased to 652 in 2016, almost a 70% higher than the average of previous years. Due to these establishments are situated in zones with less employment opportunities, these companies are elements of rural development.

Although production volume and value increased in 2016 (16 743 tonnes valued €44.2 million), operational cost and depreciation of capital increased in the same proportion that turnover, what limited the benefits of higher incomes. Total operational cost increased almost 10% 2016. Cost structure in trout production has remained stable in recent years. As in other fish productions, the main operational cost is feed, that in 2016 achieved the 38% of the total cost production. Since 2014, the increase in livestock costs has improved its relevance in detriment of feed costs. In this segment wages and salaries supposes 23% of the total operational costs.

Despite the increase in turnover and sales volume, the economic performance indicators have followed a negative trend. Between 2013 and 2016, GVA decreased 60% from €25.4 million to €10.8 million. Net profit experimented the same evolution and it was €-0.6 million and €-0.9 million. This means that trout production generated negative economic returns for owners in the last two years analysed.

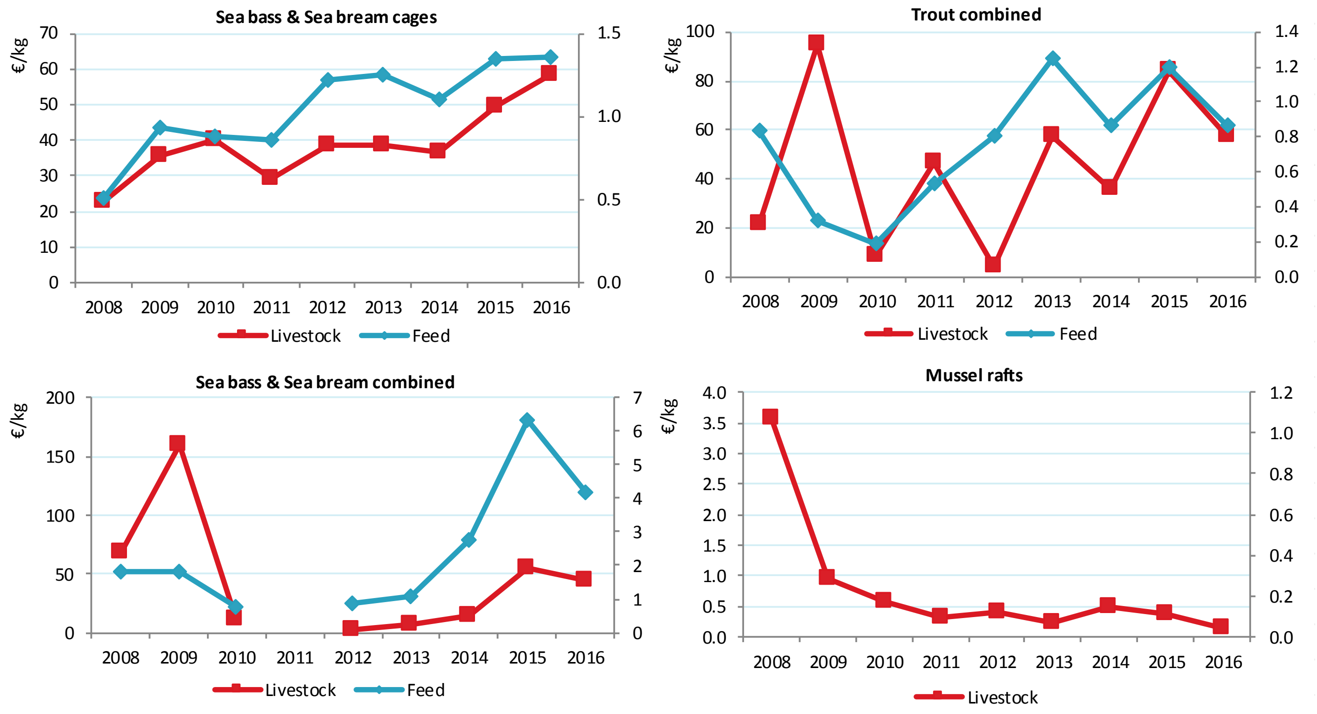

Figure 4.25.9 Feed and livestock prices for the main Spanish segments: 2008-2016.
Source: EU Member States DCF data submission

4.25.5 Trends and triggers

Current production trends and main drivers

The increase in production observed in the period 2013-2014 appears to conclude in the two years added to the observed series. Total production slightly increased in 2015 and decreased in 2016. Prices, on their side, remained stable in the same years. Despite this flattened trend in production volumes, net profit increased in the last two years as a potential result of improved efficiency. The above picture changes when moving across segments.

Marine finfish production in 2016 remained at similar levels as in the previous year which is around a 10% larger than in 2014. Prices for this segment increased for seabream but decreased for seabass and Bluefin tuna due to different causes related with market substitution. An increase in the Mediterranean Bluefin tuna catches has resulted in lower prices both of final product and juveniles. At the end, despite the decrease in the price of tuna, the companies are still profitable. The bass and bream industry had positive profits for third consecutive year, after a long period with loses, but the rate of recovery has diminished. It is soon to say whether this is just a circumstantial change or the beginning of a new decreasing price cycle in the Mediterranean industry. Exports of bass and bream have increased in the last years, resulting in an increase in overall turnover due to better price per unit sold.

After several years decreasing volumes, trout farming increased production on an average 5% in the last two years covered, which may be behind the change in the increasing trend of prices. The industry persists in the importance of product differentiation in various ways, including processing and organic farming. to labelling and certifications. However, net profit has been negative and decreasing in the last two years covered. The evolution of the industry performance in the short term will depend on the reaction of consumers to a decrease in price. If price sensitivity shows to be strong, the increase in production could be sustained and the industry could drive to a profitable dimension.

Shellfish farming is mainly driven by mussels and subjected to changing environmental conditions. The industry has a strong social and economic impact in the surrounding communities both in terms of direct and indirect employ and income. The main factor affecting this industry is the frequency of the red tide, which prevents the shellfish harvest in the region of Galicia, were over 95% of the National production is located. When the frequency along the year is so high, the volumes of production dramatically decrease until return to the usual levels when the water conditions recover. Both production and prices remained stable in the last years. The industry keeps being profitable however well fragmented in many family-owned business, preventing economies of scale and improved profits. Efforts are being taken in the form of producers' cooperation, since several years ago, focused in concentrating volumes and downstream integration in order to avoid the above mentioned bottlenecks and improve margins and profits.

Market structure

Spain is a large and well diversified market for fish and shellfish in which per caput consumption doubles the EU average rate. The market structure suffered significant changes in the last two decades with an increase in the market share of supermarkets at the cost of the traditional outlets. This trend appears having reach an equilibrium with a relatively stable 70 to 75% market share for supermarkets and retail chains, which persists in the last years. Upstream integration undertaken by the large retail chains changed also the structure in the wholesale segment, where the public platform MERCA decreased the sale volumes below 50% of total seafood traded in the country. Because of this process of "supermarketization", retail chains became the main customers of most aquaculture companies. However, traditional outlets are still an interesting channel for niche markets searching for a higher quality standard and other non-physical incentives. These segments are very receptive to denominations of origin, and production systems alternative to cage culture like organic, semi-intensive aquaculture and integrated multi trophic aquaculture (IMTA).

Aquaculture markets are, in general, well integrated. Spanish producers are in direct competition with imports of the same species and their prices are associated in an economic relation of substitution. In other words, a shock in the international price will be followed by a shock in the price paid for domestic production. The "grown in" attribute has shown a relevant impact in differentiating products and prices in different species. Actions focused on highlighting the country or region of origin, such as "Mejillón de Galicia" or "Crianza de Nuestros Mares", increase consumer's loyalty and are expected to allow premium prices. Substitution across farmed and wild species is also frequent in the finfish market and especially relevant when the price gap increases. Consumers' preferences for wild species against farmed negatively affects purchase choices when the price of farmed fish goes up.

Consumer preferences are still rooted in fresh seafood. The penetration of processed products varies significantly across species. Some high consumed species like cod, tuna or anchovies have been traditionally sold preserved in any form and processed products hold a relevant market share. Other species which are usually consumed fresh move much slower in value addition by processing, but penetration is increasing year after year. Demand for low level processed products like fillets has increased in the last decade, in special what regards to frozen fillets. The penetration of precooked preparations is still very slow, despite recent product innovation and promotion.

Issues of special interest

The menace of increasing frequency of red tidal is a main issue in the shellfish industry in general and in mussels. The production volumes in this industry is strongly dependent on unpredictable environmental conditions affecting the revenues and likelihoods of producers. Improved predictive models and programs to minimize economic loses will be potential tools to focus in the future.

Recent increase in exports in the seabass and seabream industry has contribute to improve the returns of the exporting companies. Persisting effort in consolidation and adaptation to the preferences of the destination markets will help stabilize companies' incomes and improve profits. Exports also contribute to partially avoid the consequences of turbulence in the domestic market.

The increasing quota for Atlantic Bluefin tuna in the Mediterranean has resulted in a decrease in the price of livestock for tuna farmers, who have seen their profits increase despite of the subsequent decrease in the price of their final product.

Outlook for future production trends

Mussel farming will sustain the levels of production meanwhile the red tidal threat does not become persistent in increasing frequency. This is an unpredictable factor which may decrease production by half in one year, although recovery is immediate. The growth in this industry is limited by space availability in Galicia, which reached the maximum more than a decade ago.

The evolution in the production of seabass and seabream shows a pattern of substitution among the two species, normally farmed by the same companies. Production of seabream decreased in the last few years at the same time seabass output was increasing. The immediate consequence of these trends in production was a raise of seabream prices and a fall in seabass. The trends will persist until seabass prices reach a minimum in terms of profitability and the trends will revert. This cyclical market dynamic has been repeatedly frequent in the evolution of this industry along all Mediterranean countries.

Trout farming is still in financial and economic difficulties. However, production has increased in the last year. The fall in the price linked with the increase in supply will be critical to secure increasing production in the future.

4.25.6 Data Coverage and Data Quality

Data quality

The Spanish authorities conduct two surveys targeting to the aquaculture industry. In 1999 the Activity Survey started, to get information about the activity of the aquaculture facilities, especially the species produced under different production systems and the employment in the industry. The second is the Economic Survey which collects information on economic indicators since 2008.

Both surveys are programmed and developed at the same time, once a year, using the same target population and in a single field work. The sample is selected at the facility level. Each survey has its own questionnaire, getting information for different variables, except the value for the production (collected in both questionnaires). In this case, individual answers are checked and if there are inconsistencies, they are checked and if mistakes are found then they are corrected. Thus, the consistency between both surveys is guaranteed.

Data are collected using combined methods; part of the interviews are made on a census basis and in another part a stratified sample is used. Sampling is used in the population of mussel in rafts in Galicia due to the large population. The segmentation used in Economic Survey uses a typology of aquaculture facilities which is coherent with the established groups by the Commission Decision 2010/93/UE.

If an enterprise produces more than one species, it has been allocated to the segment of the species with a higher turnover. When a company owns more than one facility, different solutions can be applied.

Data availability

Data for the aquaculture sector is published once a year in Fisheries Statistics in Ministry of Agriculture, Food and Environment`s website at the end of the next year. Data can be consulted in this website in three different ways:

- Using a query builder, so that each user generates its own results.
- With predefined tables of establishments, production, employment and food supply.
- Downloading the data base. In this case, queries are performed with Microsoft EXCEL program, by means of pivot tables previously generated by the system; in this case the user can perform a large number of queries.

Confidentiality

Public statistics law forces to protect data`s confidentiality supplied by informants. This law dedicates its chapter III to the statistical confidentiality, saying in any case, statistics cannot disclose personal data. This confidentiality protection forces even not to publish much disaggregated information to avoid identification of the informant. This has been respected in all moment, so the different segments provided in Spain have more than one enterprise.

Differences in DCF data compared with other official data sources

The Spanish data for DCF is in line with both value and production registered in FAO and EUROSTAT, because they come from the same sources.

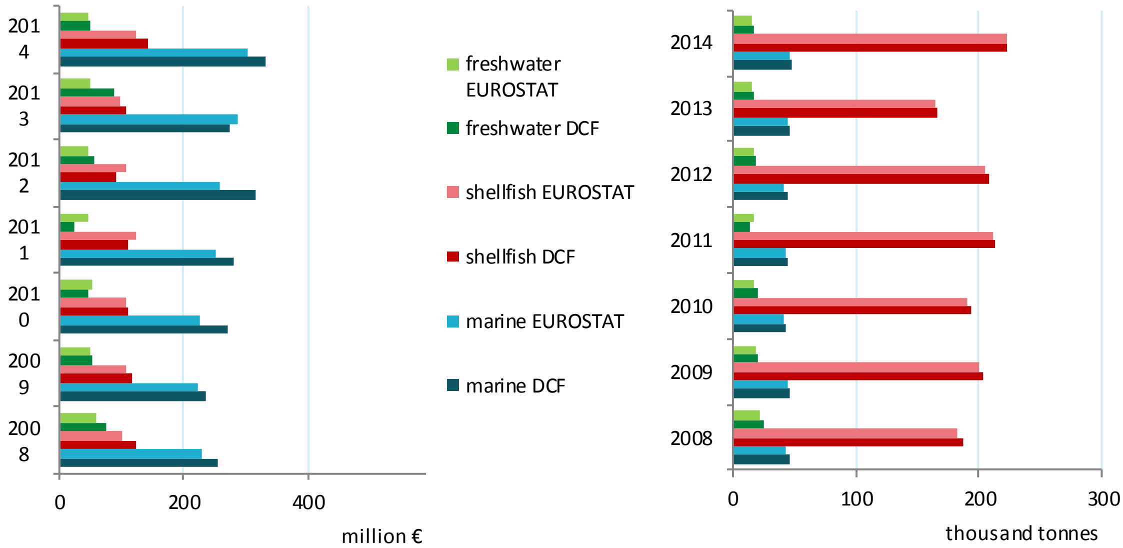

Figure 4.25.10 Comparison of DCF data with EUROSTAT data for Spain: 2008-2014

4.26 Sweden

4.26.1 Production and sales

The production of Swedish aquaculture in 2016 was 16 600 tonnes of fish and shellfish, dominated by Rainbow trout which represented 74% of the total production. The production of Arctic char amounted to 1 800 tonnes, and production of cultivated Blue mussels was 2 300 tonnes. Production volumes for 2016 indicate an increase by 25% compared to 2015. The value of aquaculture production was €58.6 million in 2016, also indicating an increase of 10% compared to 2015 (Table 4.26.1).

Table 4.26.1 Production and sales for Sweden: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/ (08-15)
Sales weight (thousand tonnes)	***8.9***	***10.4***	***11.7***	***14.5***	***14.8***	***14.4***	***14.0***	***13.4***	***16.6***	*25%*	*30%*
Marine			0.0	0.0	0.0	0.0					*0%*
Shellfish		2.1	1.4	1.5	1.3	1.7	1.8	1.5	2.3	*52%*	*44%*
Freshwater	6.3	8.2	10.3	13.0	13.5	12.7	12.3	11.8	14.1	*19%*	*28%*
Hatcheries & nurseries			0.0	0.0	0.0	0.0			0.2		
Sales value (million €)	***34.5***	***29.4***	***41.2***	***47.5***	***49.8***	***50.3***	***56.9***	***53.3***	***58.6***	*10%*	*29%*
Marine			0.0	0.0	0.0	0.0					*0%*
Shellfish		1.1	0.8	1.0	1.0	1.3	1.3	1.1	1.6	*49%*	*47%*
Freshwater	27.2	28.3	40.4	46.5	48.7	49.0	55.6	52.2	55.2	*6%*	*27%*
Hatcheries & nurseries			0.0	0.0	0.0	0.0			1.8		

Source: EU Member States DCF-EUMAP data submission

4.26.2 Industry structure and employment

Sweden has favourable natural prerequisites for aquaculture with a large number of freshwater areas and a long coastline. Enterprises are located across all of Sweden but a majority of these are sited in rural areas. The major trend over the last decade has been that production levels increase while the number of firms decrease (Table 4.26.2). However, in 2016 the number of enterprises increased by 8% as an effect of an increase in both smaller companies (<=5 employees) and large companies (>10 employees).

In 2016 the Swedish aquaculture sector employed 489 persons, corresponding to 317 FTEs. During the last year, the number of employees increased by 19%. During the full reported period, the number of employees shows a 22% increase. The sector is characteristically dominated of male employees (both in numbers and FTEs), with only 18% female FTEs in 2015 (EUMAP economy data for 2016 does not include gender). The data show a trend of increasing total employment in terms of number of employees as well as FTE.

The average FTE per enterprise for the whole period has increased by 39% while the average wage decreased in 2015 and 2016. The decrease in wages may be an effect of different data sources and response rates from the aquaculture sector. The labour productivity has been increasing after a drop in 2012 (Figure 4.26.1).

Table 4.26.2 Structure of the Swedish aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/ (08-15)
Structure (number)											
Total enterprises	*155*	*192*	*175*	*153*	*147*	*144*	*142*	*126*	*136*	*8%*	*-12%*
<=5 employees	142	182	162	139	135	130	128	108	115	*6%*	*-18%*
6-10 employees	9	7	10	10	9	9	8	13	10	*-23%*	*7%*
>10 employees	4	3	3	4	3	5	6	5	11	*120%*	*167%*
Employment (number)											
Total employees	*379*	*424*	*399*	*392*	*370*	*420*	*411*	*411*	*489*	*19%*	*22%*
Male employees	321	367	356	343	317	354	345	336			
Female employees	58	57	43	49	53	66	66	75			
FTE	223	222	230	263	263	304	278	241	317	*32%*	*25%*
Male FTE	199	201	209	235	232	266	249	197			
Female FTE	24	22	21	28	31	38	29	44			
Indicators											
FTE per enterprise	1.4	1.2	1.3	1.7	1.8	2.1	2.0	1.9	2.3	*22%*	*39%*
Average wage (thousand €)	29.0	24.4	28.6	32.1	33.4	32.9	44.5	38.2	28.4	*-26%*	*-14%*
Labour productivity (thousand €)	48.9	39.3	-155.7	58.0	45.6	61.9	65.5	66.7	70.0	*5%*	*143%*

Source: EU Member States DCF-EUMAP data submission

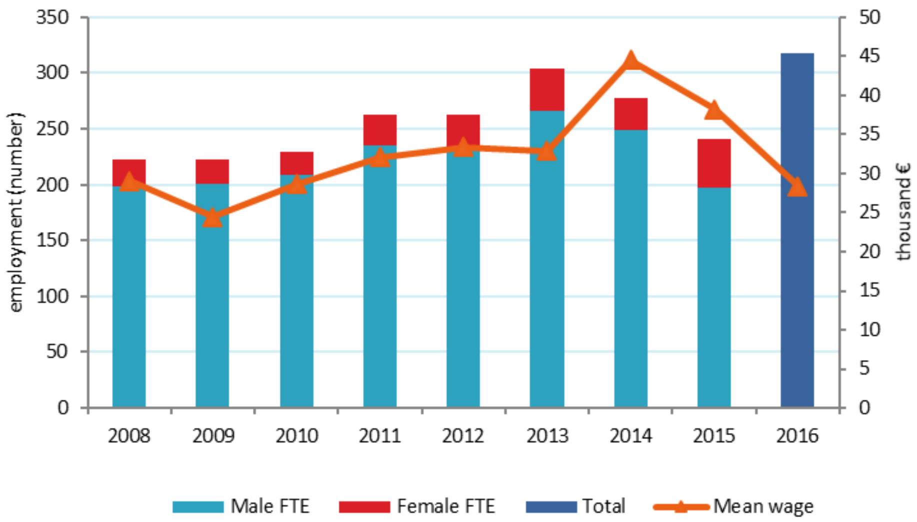

Figure 4.26.1 Employment trends for Sweden: 2008-2016.
Source: EU Member States DCF-EUMAP data submission

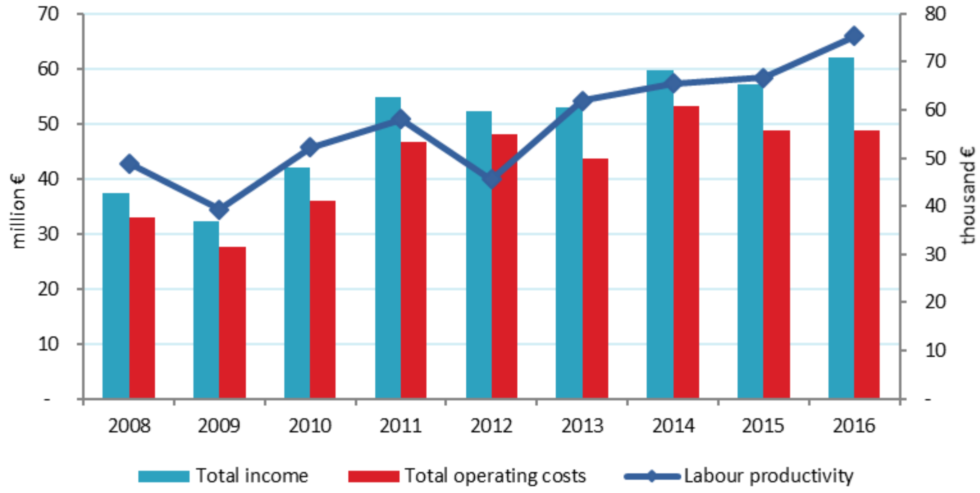

Figure 4.26.2 Income, costs, wages and labour productivity trends for Sweden: 2008-2016.
Source: EU Member States DCF-EUMAP data submission

4.26.3 Economic performance

Turnover is the main source of income for enterprises in the Swedish aquaculture sector. In 2016, the share of total income was 96% and has remained at a similar level over the covered time period. The cost structure shows that the main operational expenditures for aquaculture firms are the cost of raw material (feed and livestock), labour (wages and salaries) and other operational costs. Both energy cost and imputed value of unpaid labour makes out a small share of total income, of less than 5% (Table 4.26.3).

The total expenditures have decreased over the last two years (2015 and 2016) and in 2016 it represents 79% of the total income (Table 4.26.3). The expenditures were dominated by cost of feed (35%), cost of livestock (6%), cost of wages and salaries (15%, including imputed value of unpaid labour) and other operational costs (16%) in 2016. Even though they are small, costs for energy and maintenance have the highest increase during the period. Costs and weight of raw material (feed and livestock) should be considered with caution due to a low response rate from large enterprises.

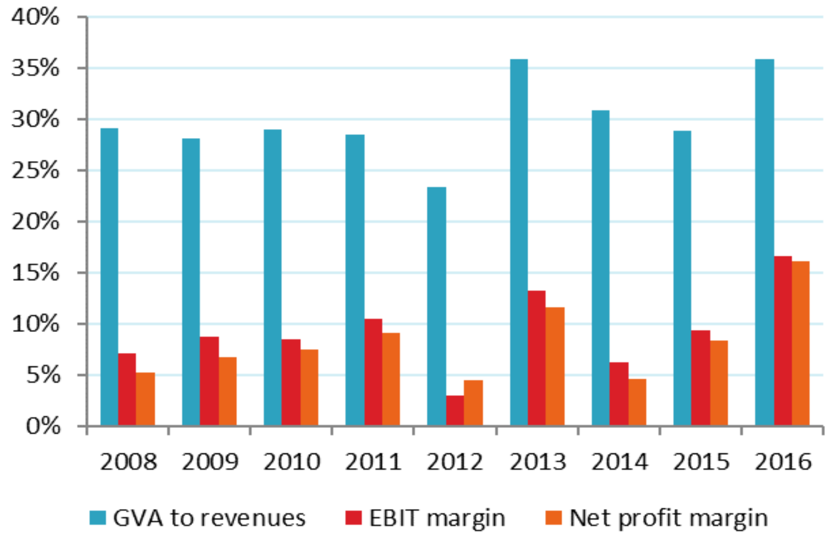

Figure 4.26.3 Economic performance for Sweden: 2008-2016
Source: EU Member States DCF-EUMAP data submission

Table 4.26.3 Economic performance of the Swedish aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	*% of total income*	Change 2016-15	Development 2016/(2008-15)
Income (million €)												
Turnover	34.5	29.4	41.2	47.5	49.8	50.3	56.9	53.3	59.7	*96%*	*12%*	*32%*
Other income	2.9	1.6	0.2	6.1	1.4	2.1	2.1	2.4	2.2	*4%*	*-8%*	*-5%*
Subsidies	0.0	1.3	0.7	1.2	0.9	0.4	0.8	1.5	0.0	*0%*	*-100%*	*-100%*
Total income	*37.4*	*32.3*	*42.1*	*54.8*	*52.1*	*52.9*	*59.8*	*57.2*	*62.0*	*100%*	*8%*	*28%*
Expenditures (million €)												
Wages and salaries	6.2	5.2	6.4	8.2	8.5	8.8	10.9	8.1	8.4	*14%*	*3%*	*8%*
Imputed value of unpaid labour	0.3	0.2	0.2	0.2	0.3	1.2	1.5	1.1	0.6	*1%*	*-40%*	*2%*
Energy costs	1.6	1.3	1.3	1.4	1.3	1.5	1.9	1.4	2.4	*4%*	*69%*	*63%*
Repair and maintenance	1.4	1.2	1.6	2.0	2.1	1.0	1.2	0.9	2.0	*3%*	*116%*	*40%*
Raw material: Feed costs	14.4	12.2	17.0	22.6	23.1	23.2	25.8	25.8	21.7	*35%*	*-16%*	*6%*
Raw material: Livestock costs	4.1	3.4	4.3	5.4	5.7	4.1	4.7	4.5	3.9	*6%*	*-14%*	*-14%*
Other operational costs	5.1	4.3	53.1	6.9	7.1	3.8	7.3	7.1	9.9	*16%*	*40%*	*-16%*
Total operating costs	*32.9*	*27.7*	*83.8*	*46.7*	*48.0*	*43.6*	*53.2*	*48.9*	*48.8*	*79%*	*0%*	*1%*
Capital Costs (million €)												
Depreciation of capital	1.8	1.8	1.8	2.2	2.6	2.3	2.8	3.0	2.8	*5%*	*-5%*	*24%*
Financial costs, net	0.7	0.6	0.4	0.8	-0.8	0.8	1.0	0.6	0.3	*1%*	*-39%*	*-33%*
Extraordinary costs, net	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0				
Capital Value (million €)												
Total value of assets	46.5	34.9	48.6	61.5	63.3	64.8	65.6	65.7	64.0	*103%*	*-3%*	*14%*
Net Investments	4.1	5.0	4.9	2.9	1.0	1.3	0.7	2.4	1.9	*3%*	*-21%*	*-31%*
Debt	18.3	17.2	22.5	44.9	41.1	44.3	46.8	41.1	33.9	*55%*	*-17%*	*-2%*
Input & Production (thousand tonnes)												
Raw material: Feed	14.2	13.1	16.5	15.4	21.5	20.0	19.7	18.6	7.5		*-60%*	*-57%*
Raw material: Livestock	0.9	0.8	1.0	1.7	1.3	1.3	0.9	0.6	0.2		*-65%*	*-79%*
Performance Indicators (million €)												
Gross Value Added	10.9	8.7	-35.8	15.3	12.0	18.8	18.2	16.1	22.2	*36%*	*38%*	*177%*
Operating cash flow	4.5	4.6	-41.7	8.0	4.2	9.3	6.6	8.4	13.2	*21%*	*58%*	*2654%*
Earning before interest and tax	2.7	2.8	-43.6	5.8	1.6	7.0	3.8	5.4	10.3	*17%*	*93%*	*670%*
Net profit	2.0	2.2	-44.0	5.0	2.4	6.2	2.8	4.8	10.0	*16%*	*108%*	*529%*
Capital productivity (%)	23.5	25.0	-73.8	24.8	19.0	29.0	27.8	24.5	0.0		*-100%*	*-100%*
Return on Investment (%)	5.7	8.1	-89.7	9.4	2.5	10.8	5.8	8.2	0.0		*-100%*	*100%*
Future Expectation Indicator (%)	5.0	9.2	6.3	1.1	-2.6	-1.5	-3.3	-0.9	0.0		*100%*	*-100%*

Source: EU Member States DCF-EUMAP data submission

The gross value added for the sector as a whole has increased since 2008. In 2016 both EBIT and net profit was higher than previously reported at 17% and 16%, respectively. The net profit for 2016 was over €10 million and the GVA accounted for €22 million.

4.26.4 Main species produced and economic performance by segment

Since 2016 the Swedish aquaculture industry is divided into seven segments according to EUMAP:

1. Other freshwater fish – Cages
2. Other freshwater fish – Tanks and race-ways
3. Other freshwater fish – Ponds
4. Other freshwater fish – Recirculation systems
5. Other freshwater fish – Hatcheries and nurseries
6. Crustaceans – Other
7. Mussel – Other

However, to be able to follow the development over time the production in Sweden is aggregated into three main segments.

1. Other freshwater fish – Cages, same as EUMAP
2. Other freshwater fish – On growing, includes EUMAP 2, 3 and 4 as well as previous DCF segmentation Trout On growing
3. Other shellfish – Other, same as EUMAP 7

The largest segment in Swedish aquaculture, in terms of both value and volume of production, is freshwater fish grown in cages. The second most important segment is freshwater fish on growing. The third segment consists of shellfish (blue mussels and oysters). There are six main species produced in Sweden, rainbow trout, blue mussel, arctic char, Atlantic salmon, European eel and noble crayfish as well as a group of other freshwater fish (Figure 4.26.4).

Figure 4.26.4 Main species in terms of weight and value in Sweden production: 2016.
Source: EU Member States DCF-EUMAP data submission

Aquaculture farms in freshwater have a huge dominance in Sweden – both in production and value. Other methods for aquaculture in Sweden are ponds and pools. Rarer are recirculating systems. Rainbow trout is the most important specie in Sweden and is produced in most geographical regions. Cages are the most common farming technique.

In 2016, Swedish aquaculture yielded 14 100 metric tonnes of fish (in fresh weight) of which 13 450 tonnes were produced for human consumption. The dominating species was Rainbow trout, with 74% of the total production and 76% of the value. The production of Arctic char yielded the second highest value whereas blue mussel stood for the second highest production. The total value of aquaculture production amounted to €58.6 million, an increase by €5.3 million compared to 2015.

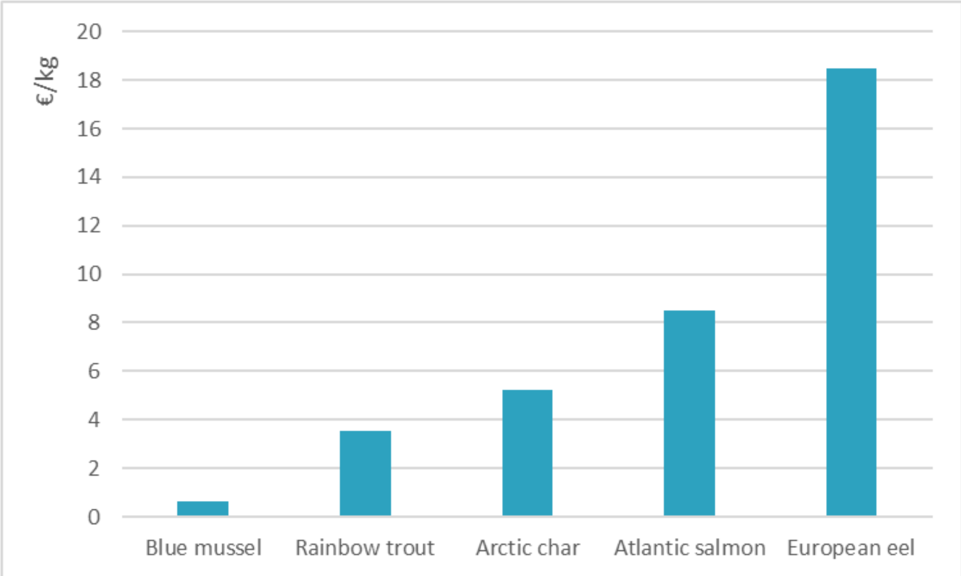

Figure 4.26.5 Average prices for the main species produced in Sweden: 2016.
Source: EU Member States DCF-EUMAP data submission

Rainbow trout is the most important specie both in terms of weight and value. However, European eel yields the highest value per weight in Sweden but the production is less than 1% of the total aquaculture production. Atlantic salmon production in Sweden is almost exclusively for stocking purposes hence the high value per kilo (Figure 4.26.5).

The most relevant segments in the Swedish aquaculture are analysed below.

Segment 1: Other freshwater fish in cages

The segment *Other freshwater fish cages* corresponds to the same segment in the new EUMAP as previously reported.

The value and volume of production of segment 1 has grown between 2008 and 2012 and the figures indicated that the segment was experiencing progress in the economic indicators. However, the positive trend observed between 2008 and 2012 was changed to a negative trend in 2013 and 2014. This decline was broken in 2015 and production increased further in 2016. The segment produced 83% (13 700 tonnes) of total aquaculture production in Sweden in 2016 and the total income accounted for 87% (€53.7 million) of total income. Total sales volume in segment has increased with 38% during 2008-2016 from 5.8 to 13.7 thousand tonnes and gross value added increased from €5.8 to €29.9 million.

Segment 2: Other freshwater fish on growing

The segment *Other freshwater fish on growing* is aggregated to be able to study development over time. The segment includes the previous segment *Trout on growing* as well as new EUMAP segments *Other freshwater fish tanks and raceways*, *Other freshwater fish ponds* and *Other freshwater fish RAS*. This segment contains all species of freshwater fish and aquaculture production both for stocking as well as consumption.

This is the second largest segment in terms of production value. In 2016, the segment produced 4% (600 tonnes) of total production and the total income accounted for 10% (€6.3 million). The production volume has varied over time with a peak at 2.0 thousand tonnes in 2014. However, the production in 2016 was only 0.6 thousand tonnes. The low production is also reflected in a lower income (€6.3 million), gross value added (€1.4 million) and for the first time since 2008 a negative profit (€-0.6 million). The low performance of this segment can have several causes. One of the causes may, to some extent, be correlated to the increase in segment 1. It can also be an effect of the change in segmentation where the farmers choose which segment represents the enterprise best. Some of the bigger enterprises tends to go towards combined systems where they have the whole chain from roe to fish for consumption, since the cage production is their largest production they will classify themselves as *Other freshwater fish cages*.

Segment 3: Other shellfish other

The third segment *Other shellfish other* consists of enterprises producing mussels and oysters. Previously (until 2015), enterprises producing freshwater crayfish was also included. This segment represents 14% (2 300 tonnes) of Sweden's total aquaculture production in terms of weight but only 3% (€1.9 million) in terms of value. The income has been stable for this sector but the production increased by 53% in 2016 compared to 2015.

Figure 4.26.6 shows that the FTE and total value of assets in the Swedish aquaculture sector has remained stable, and the turnover has increased slightly. The total sales volume showed a substantial increase in 2016.

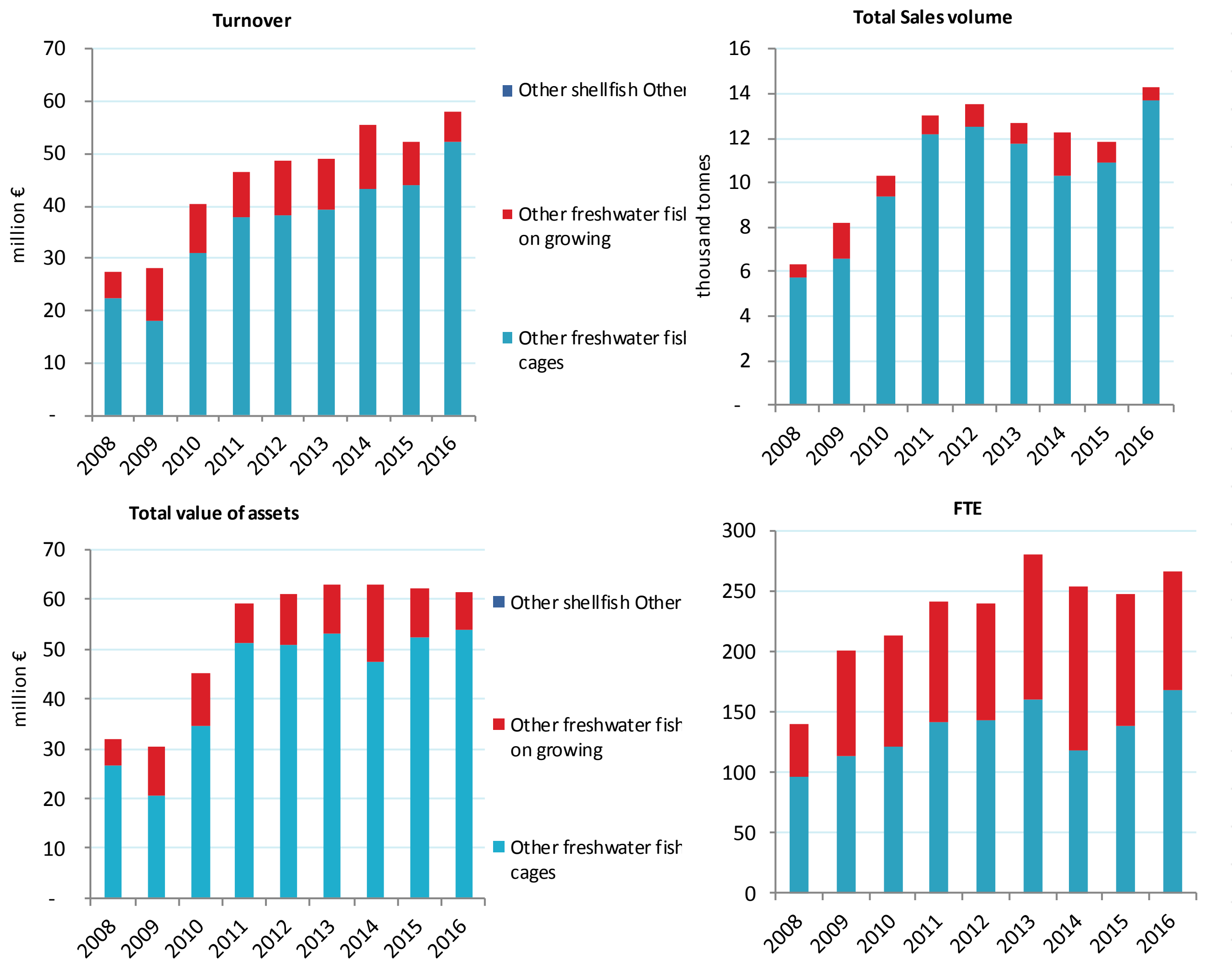

Figure 4.26.6 Structural development Swedish aquaculture sector: 2008-2016.

Source: EU Member States DCF-EUMAP data submission

The economic performance of the three Swedish segments is shown in Table 4.3.4. This table show a positive gross value development from 2008 until 2016 for segment 1 and 3 but segment 2 shows a substantial decrease (-67%).

Table 4.26.4 Economic performance of main Swedish aquaculture segments: 2008-2016 (in million €).

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	% of total income	Change 2016/15	Development 2016/(2008-15)
Other freshwater fish cages												
Total income	23.1	19.4	31.1	43.6	39.2	40.8	43.7	46.3	53.7	100%	16%	50%
Gross Value Added	5.8	4.6	8.4	11.8	7.8	11.9	9.4	10.1	29.9	56%	197%	243%
Operating cash flow	2.3	1.6	3.8	5.4	1.5	4.9	0.9	3.6	23.3	43%	548%	680%
Earning before interest and tax	1.3	1.0	2.5	3.8	-0.5	3.2	-1.0	1.4	21.0	39%	1411%	1342%
Net profit	1.1	0.6	2.2	3.2	0.2	2.5	-1.6	0.9	20.7	38%	2133%	1720%
Total sales volume (thousand tonnes)	5.8	6.6	9.4	12.2	12.6	11.7	10.3	10.9	13.7		26%	38%
Other freshwater fish on growing												
Total income	4.7	9.4	8.8	8.5	10.2	9.7	13.5	8.0	6.3	100%	-21%	-31%
Gross Value Added	1.4	3.6	3.2	3.0	3.5	6.1	8.0	5.3	1.4	22%	-73%	-67%
Operating cash flow	0.5	1.7	1.5	1.4	1.5	3.4	4.4	3.0	-0.4	-7%	-114%	-119%
Earning before interest and tax	0.2	1.1	1.1	0.9	1.1	2.9	3.8	2.6	-0.7	-10%	-125%	-139%
Net profit	0.0	1.0	1.0	0.7	1.1	2.8	3.3	2.6	-0.6	-10%	-124%	-140%
Total sales volume (thousand tonnes)	0.5	1.6	0.9	0.9	0.9	1.0	2.0	1.0	0.6		-38%	-46%
Other shellfish Other												
Total income		2.2	1.5	1.5	1.8	1.9	1.8	1.5	1.8	100%	19%	2%
Gross Value Added		0.6	0.4	0.5	0.7	0.8	0.8	0.8	1.0	58%	30%	55%
Operating cash flow		0.0	0.1	0.1	0.2	0.6	0.5	0.3	0.5	27%	60%	97%
Earning before interest and tax		-0.6	0.0	0.0	0.1	0.5	0.3	-0.1	0.4	22%	417%	4357%
Net profit		-0.7	0.0	-0.1	0.1	0.5	0.3	-0.2	0.3	19%	304%	1636%
Total sales volume (thousand tonnes)		2.1	1.4	1.5	1.3	1.7	1.8	1.5	0.2		-85%	-86%

Source: EU Member States DCF-EUMAP data submission

There are large variations in terms of production levels and the value of various economic indicators across these three segments. Rainbow trout and Arctic char grown in cages is the largest segment in terms of both volume and value of production.

The segment stands for over 80% of total aquaculture production as well as the total income in Sweden. In Table 4.3.4 and Figure 4.3.7 the economic indicators of the three main segments are presented. Earnings before interest and tax (EBIT) showed a marked increase in segment 1 and 3 however, in segment 2 there was a negative result for the first time since 2008.

In 2016 the GVA to revenue showed an increase in segment 1 with a higher percentage than all previous years. On the contrary, segment 2 showed a decrease in 2016 with a percentage lower than all previous years, as mentioned previously this may be an effect of the change in segmentation. Segment 3 has shown a slight yearly increase since 2008. The net profit follows the same trend as GVA to revenues for segment 1 and 2 but for segment 3 it fluctuates over the years with a marked increase in 2016. Operating costs have been stable for segment 3 but total income increased in 2016 explaining the increased net profit. Also, in segment 1 there are similar reports with higher income compared to operating costs and the opposite was observed in segment 2 (Figure 4.3.7).

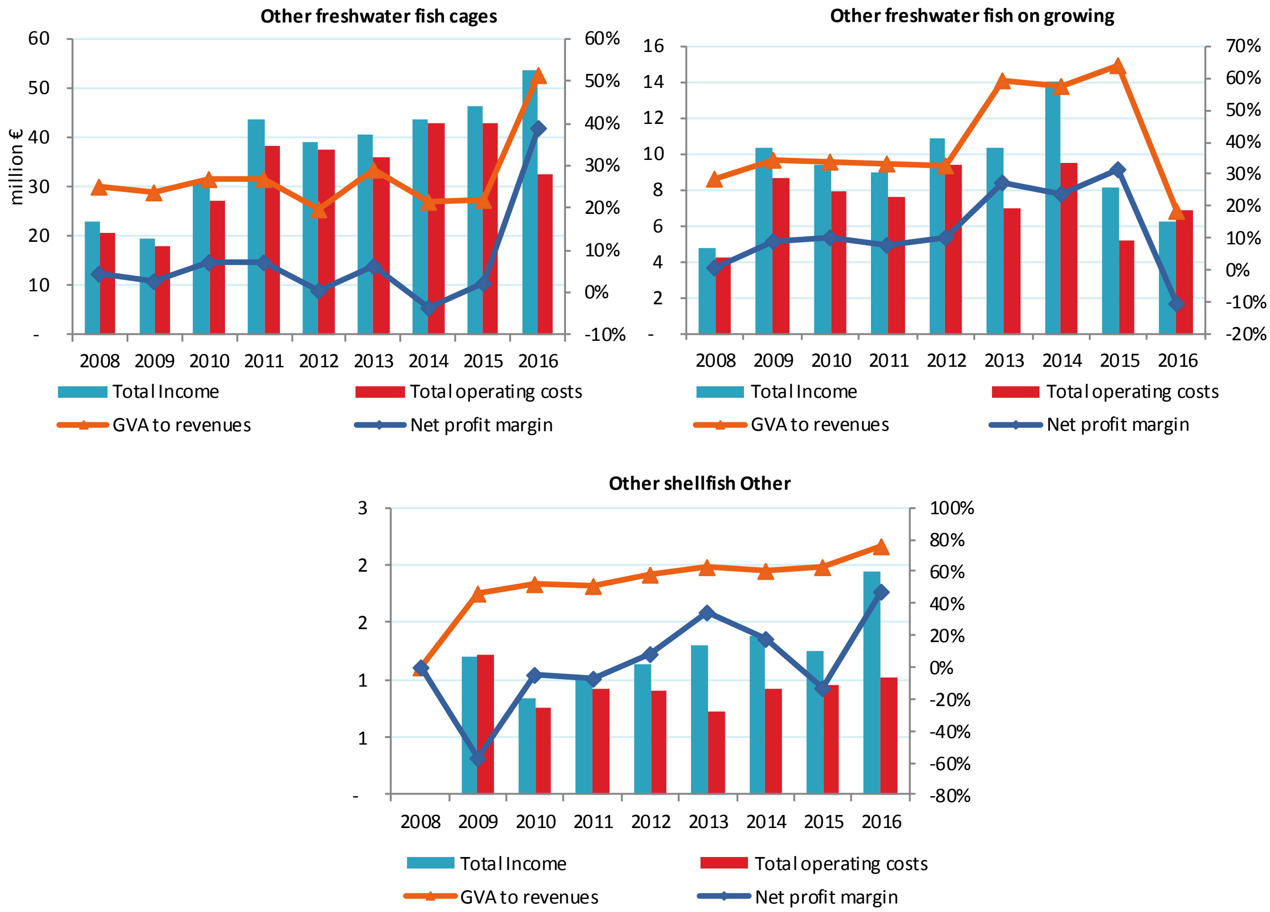

Figure 4.26.7 Economic performance indicators for the main Swedish segments: 2008-2016.
Source: EU Member States DCF-EUMAP data submission

The operational cost structures for the new Swedish segments according to EUMAP are presented in Figure 4.3.8. Due to low number of enterprises and response rate the segment *Other freshwater fish Recirculation systems* cannot be presented.

Segment: Other freshwater fish Cages

Costs in this segment are likely under valuated due to a low response rate from large enterprises but the relationship between costs are probably similar. In 2016 the feed costs were the main cost component with 30% of total operating costs in this segment. Other operational costs amounted for 26% of the total costs in 2016 and wages and salaries amounted 19%. The energy costs are of minor importance, 2% of total operational costs are due to energy costs.

Segment: Other freshwater fish Hatcheries and nurseries

In this segment the cost of feed dominated with 97% of the total costs. Energy costs, other operational costs and repair and maintenance represented 1% each of the remaining costs.

Segment: Other freshwater fish Tanks and raceways

In this segment, the costs of wages and salaries, energy, feed, livestock and other operational costs were evenly distributed with approximately one fifth for each cost. However, there were some minor costs due to unpaid labour, repair and maintenance and consumption of fixed capital.

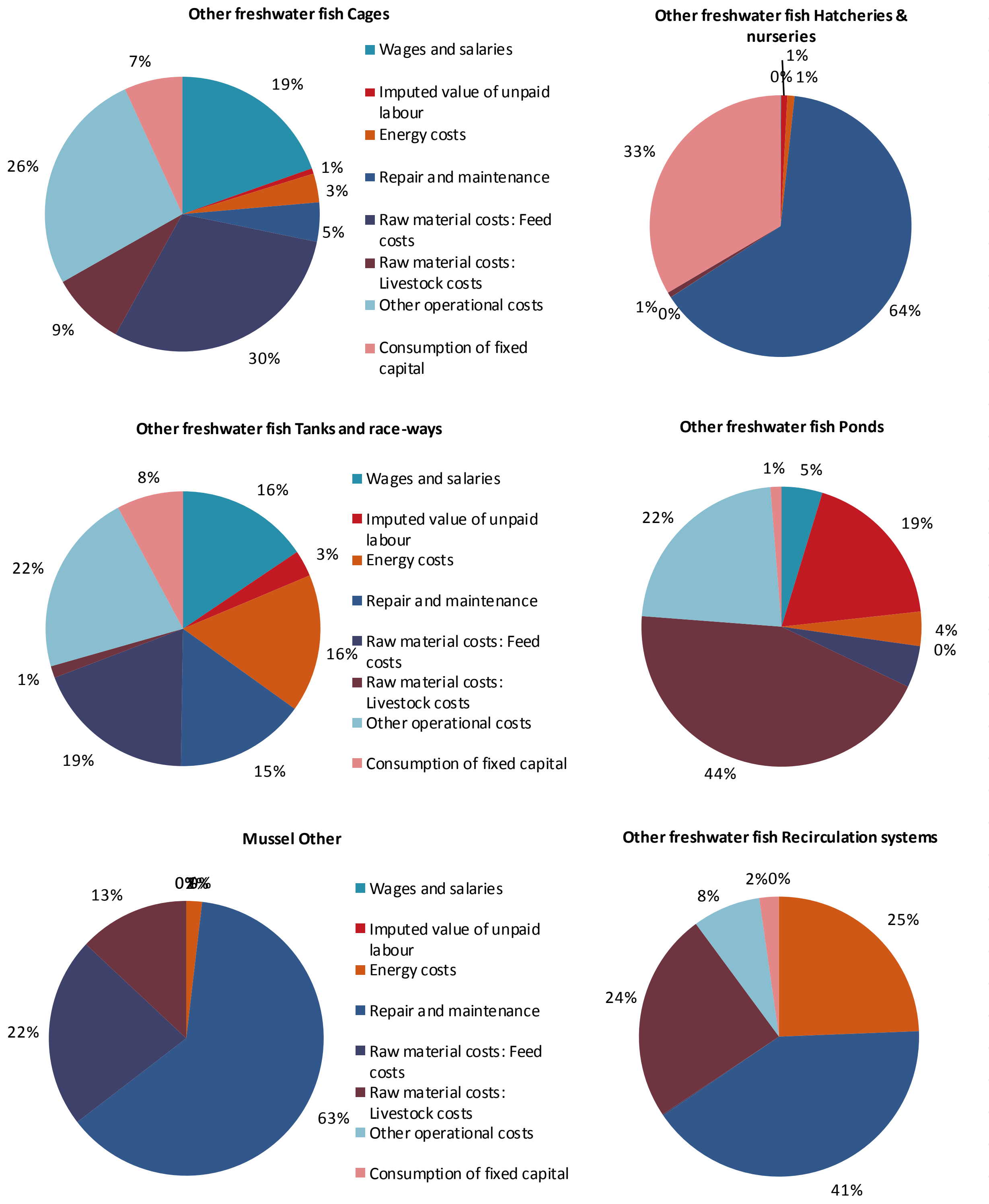

Figure 4.26.8 Cost structure of the main segments in Sweden: 2016.
Source: EU Member States DCF-EUMAP data submission

Segment: Other freshwater fish Ponds

For other freshwater fish in ponds the major costs were wages and salaries and feed costs with approximately 30% of the costs in each. Energy costs represented 11% of total costs and repair and maintenance and consumption of fixed capital each represented 8%. Livestock was only a minor cost (6%) and unpaid labour represented only 1%.

Segment: Mussel Other

The segment Mussel Other reported a cost of wages and salaries that presented over half (51%) of the total costs. Another major cost in this segment was consumption of fixed capital (39%) whereas unpaid labour, energy, repair and maintenance and other operational costs only represented a minor part of the costs.

Segment: Crustaceans Other

This segment showed a major cost for unpaid labour (59%) indicating that most people working with crustacean production have another source of income. Another large cost was the energy costs (19%). Other minor costs were livestock, repair and maintenance, consumption of fixed capital, feed and other operational costs.

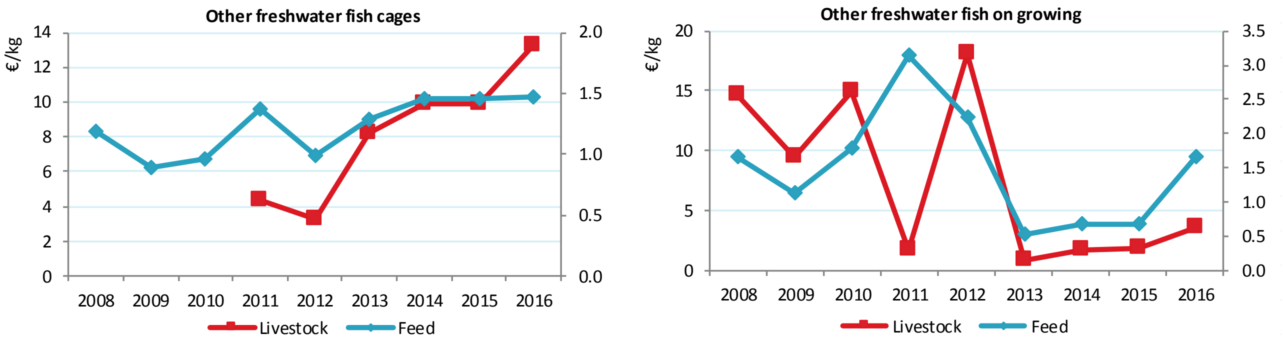

Figure 4.26.9 Feed and livestock prices for the main Swedish segments: 2008-2016.
Source: EU Member States DCF-EUMAP data submission

4.26.5 Trends and triggers

Market structure, current production trends and main drivers

The Swedish aquaculture sector has experienced an increase in volume of production. Over the last decades, production levels have increased from 5 500 tonnes (1998) to 16 600 tonnes (2016). One explanation for the observed growth in productions is likely related to structural changes in the aquaculture sector, where firms merge into larger units to exploit economies of scale. Data since 1998 show that the number of firms has decreased, at the same time average production volumes have been steadily increasing.

Between 2013 and 2015 the increase in production stalled and a minor decrease was seen these years. However, in 2016 the production recovered and was higher than any previously reported year. There are only a few large aquaculture enterprises that stands for most of the production in Sweden but many small enterprises with a limited production.

Issues of special interest

There have also been incentives at the national level to increase the knowledge about the needs for sustainable aquaculture production and ways to promote it. According to regulations of the European Maritime and Fisheries Fund 2014-2020 (EMFF), member states are obliged to develop a national aquaculture strategy in order to increase the state of knowledge about aquaculture and address future needs in order to achieve sustainable production and more efficient policies. The Swedish Board of Agriculture, managing authority of the EMFF, developed a national strategy document (Svenskt vattenbruk - en grön näring på blå åkrar, in Swedish) with the objective to identify how the Swedish aquaculture sector can grow in the direction of economic and environmental sustainability to 2020, with the main challenge of combining economic, ecologic and social cohesion. Among other things, the strategy identified the importance of cooperation among different actors in the industry and the need of spatial planning and development of new production techniques. The national strategy for Swedish aquaculture constituted the main foundation for constructing a national action plan for sustainable development of Swedish aquaculture.

Outlook for 2017 and 2018

Sweden's net imports of fish, crustaceans and molluscs were considerably higher than the production in 2016. Swedish aquaculture could gain a larger share of the domestic market, where demand for cultivated fish products is high.

There is an increasing demand for sustainably produced seafood from the public in Sweden. There are also political initiatives that aims at developing and increasing the Swedish aquaculture production. In 2017 the Government put forward an action plan stemming from “A National Food Strategy for Sweden – more jobs and sustainable growth throughout the country. 2016/17:104”. The strategy lifts the potential of future aquaculture and concludes that “seafood and marine resources have the potential to meet increased demands. Areas of water should be made available for sustainable aquaculture, such as fish, shellfish, oyster and mussel farms, so as to strengthen the Swedish aquaculture industry”. Aquaculture is included in the action plan and funds that will contribute to a sustainable development has been allocated. Funds have not been granted to enterprise investments but to projects that will help the whole industry to develop.

Unfortunately, the Swedish aquaculture industry has received some major setbacks in 2017 and 2018 that will likely affect the future production in Sweden. Several farms have been denied new or increased environmental licenses due to new interpretations of the environmental legislation. Some were given the opportunity to change techniques to more environmentally friendly techniques but others are forced to close down. Due to these new verdicts in the Land and Environmental Court of Appeal, the largest production segment in Sweden (freshwater fish in cages) needs to change to more environmentally friendly techniques. This will require large investments and in the European Maritime and Fisheries Fund (EMFF) funds have been allocated to support environmental investments for aquaculture.

The Swedish aquaculture sector also face difficulties related to regulations and implementing new production techniques at a commercial scale. There is an ambition to increase aquaculture production using new sustainable production techniques, however, most of this work is still on project levels and has not reached commercial scales. The production of marine shellfish products is currently small in relation to freshwater production, although Sweden has significant production of organic mussels (KRAV).

An analysis of the impact of administrative burdens and governance has been made, and it has been pointed out as high. In 2019 an investigation on how to adapt regulations and simplify administration will be conducted.

4.26.6 Data Coverage and Data Quality

Since 2011, the Swedish Board of Agriculture is responsible for compiling and reporting statistics on the aquaculture sector for the reported period together with the Swedish Agency for Marine Water Management. The Swedish Board of Agriculture in cooperation with Statistics Sweden conducted two questionnaires and a tax declaration survey for each year. Data is collected from both income tax declarations, administrative records and two questionnaires (Q1 and Q2), sent to all aquaculture farmers (Q1) and all aquaculture firms that have aquaculture as their main activity (Q2). In order to identify the segments, companies using more than one farming technique or growing more than one species, all production, incomes and costs were transferred to the main technique and main species based on turnover.

The questionnaire (Q1) is sent out to all aquaculture farm units and farm units are clustered into enterprises. For each enterprise, the value of sales from Q1 is compared to income as reported in the income tax declarations. Enterprises that have aquaculture as their main activity more than 50% (income from tax declarations/sales value from Q1) are considered to have their primary activity in aquaculture. These enterprises represent the population for questionnaire Q2 (the cost allocation key survey), derived from income tax declarations combined with Q2, for all aquaculture activity in Sweden.

The second questionnaire (Q2) is used to create a cost allocation key for costs that are not specified in income tax declarations, since production year 2016 (collected in 2018), it also includes social variables according to EUMAP. In 2018 the response rate for Q2 was low, 53% based on number of enterprises but only 21% of the total production. This has affected the reported data since the population is based on and correlated to enterprises. To minimize these errors in future there are plans to incorporate the two questionnaires into one in 2019.

Data availability

Data for the aquaculture sector is published once a year, in August the same year as the census.

Confidentiality

Six of the seven segments surveyed in Sweden are presented in 4.26.5. To avoid problems with confidentiality, segments should in general include more than 10 enterprises. Due to confidentiality problems the segment *Other freshwater fish Recirculation systems* is not reported in total since the response rate for Q2 was too low.

Differences in DCF data compared with other official data sources

Since data on aquaculture production is reported from the Swedish official statistics to Eurostat, there should be minor deviations in the production volumes as reported by Eurostat. Furthermore, since FAO, EUROSTAT data and DCF report data on production based on first sales the definition should not be an issue. However, as shown in Figure 4.26.10, Swedish DCF is not identical to Eurostat and FAO data. These disparities are likely a result of differences in the reference population or the definition of marine verses freshwater aquaculture. Disparities may also arise due to updates in the data mainly due to changes in the number of active enterprises.

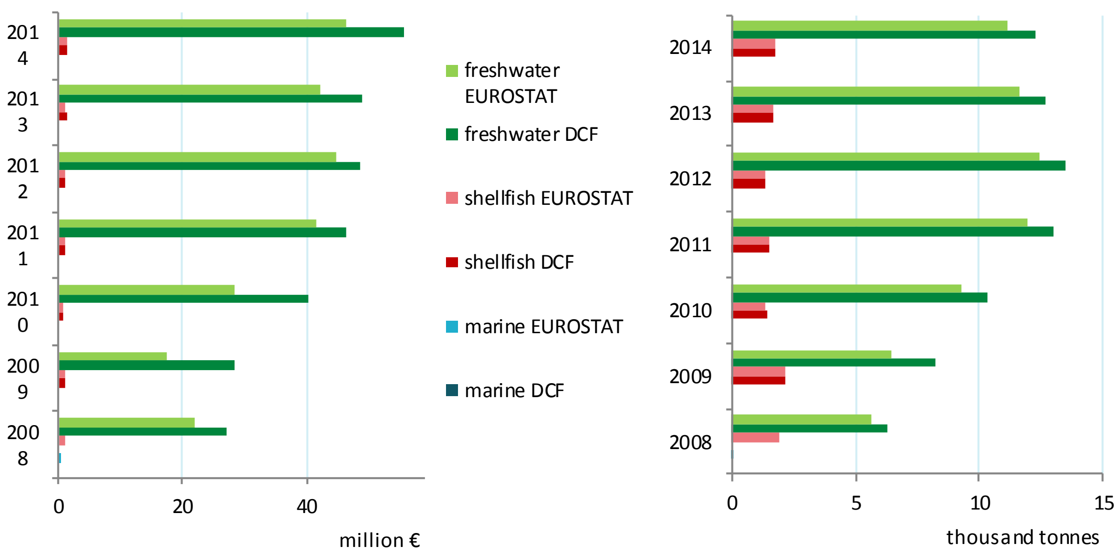

Figure 4.26.10 Comparison of DCF data with EUROSTAT data for Sweden: 2008-2016

4.27 United Kingdom

4.27.1 Production and sales

Time series (2008-2016) of reported production and estimated value for UK aquaculture are summarised in Table 4.27.1, divided into:

- Marine (finfish): Atlantic salmon, sea-bass and other marine finfish (i.e., halibut, ballan wrasse, lumpsucker);
- Shellfish: mussels, oysters (Pacific cupped oyster, European flat oyster), clams (Japanese carpet shell, northern quahog, cockles), and other shellfish (queen scallop, great Atlantic scallop);
- Freshwater: trout (all irrespective of production in freshwater or seawater: rainbow trout, sea/brown trout, Arctic char, hybrid trout), carp (common carp, Crucian carp, hybrid carp), and other freshwater fish (Nile tilapia, barbel, roach, tench, freshwater bream, chub, rudd);
- Hatcheries & nurseries: these are not reported separately for the UK because, due to vertical integration, finfish enterprises involved in this category typically also engage in ongrowing. They were previously within the "combined" segment, now "other"; additionally, hatchery and nursery production is excluded from DCF submissions due to difficulties in assigning a value to the multitude of sizes of early life stage fish sold. (N.B.: numbers produced are submitted to Eurostat under the separate EC Reg 762/2008).

Table 4.27.1 Production and sales for the United Kingdom: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/ (08-15)
Sales weight (thousand tonnes)	***185.0***	***196.5***	***201.4***	***199.0***	***203.7***	***203.3***	***214.7***	***211.8***	***194.5***	*-8%*	*-4%*
Marine	130.8	145.2	155.2	158.9	162.8	163.8	179.7	172.2	163.2	*-5%*	*3%*
Shellfish	40.7	35.6	31.5	27.1	27.4	26.3	21.6	24.2	16.9	*-30%*	*-42%*
Freshwater	13.5	15.8	14.6	13.0	13.5	13.1	13.4	15.4	14.4	*-6%*	*3%*
Hatcheries & nurseries											
Sales value (million €)	***666.4***	***559.9***	***603.4***	***758.7***	***724.6***	***896.7***	***992.6***	***999.0***	***1,023.2***	*2%*	*32%*
Marine	558.2	467.3	519.2	681.7	643.2	801.4	895.9	881.8	937.2	*6%*	*38%*
Shellfish	55.6	47.4	38.7	40.9	40.9	56.6	44.1	51.7	28.3	*-45%*	*-40%*
Freshwater	52.6	45.2	45.5	36.0	40.5	38.6	52.6	65.6	57.7	*-12%*	*23%*
Hatcheries & nurseries											

Source: EU Member States DCF-EUMAP data submission

Total sales weight and value show clear increasing trends over the time period, attributed to increasing marine production which is almost entirely composed of the salmon segment. The performance of the dominant salmon segment masks the fall in production of shellfish and the static production of "freshwater" species which is mainly rainbow trout (including seawater on-grown trout).

4.27.2 Industry structure and employment

Summary data on employment is presented in Enterprises: The situation can be considered static over the period 2008-2016; variation between years is likely to be caused by differences in classification and collation. The different administrations within the UK use different definitions to classify "Aquaculture Production Businesses" under aquatic animal health regulations, and attribution to DCF segments is somewhat open to interpretation. However, the industry continues to be composed of a range of different sized enterprises.

- Employment: Data for 2008-2010 are extrapolated from 2011. The more reliable data from 2011-2016 show a slight increase which is probably real. Although gender of employees for 2015-2016 was not requested (under EUMAP), aquaculture employment across all segments remains male-dominated.
- Indicators: DCF Economic data for 2008-2011 was not collected/submitted, so results for this period are questionable.

- FTE per enterprise appears to increase, possibly representing further consolidation within the Scottish salmon industry. However, such a mean value is considered of little use when assessing such skewed data, i.e. most enterprises are ≤5 employees.
- The average wage must be recognized as a relative measure, not an absolute value. Salary data is only estimated for the 3 main UK segments surveyed (representing ca 85% of aquaculture FTE); this total is then divided by total UK FTE (including the 6 minor segments) and is further reduced by inclusion of unpaid worker FTE. Average wage index over the period 2012-2016 appears to be consistent – around €35 thousand. The spike in 2015 (to €43 thousand) is questionable.
- Labour productivity is inconsistent over the period 2012-2016.

Table 4.27.2 and Figure 4.27.1.

- Enterprises: The situation can be considered static over the period 2008-2016; variation between years is likely to be caused by differences in classification and collation. The different administrations within the UK use different definitions to classify “Aquaculture Production Businesses” under aquatic animal health regulations, and attribution to DCF segments is somewhat open to interpretation. However, the industry continues to be composed of a range of different sized enterprises.
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- Labour productivity is inconsistent over the period 2012-2016.

Table 4.27.2 Structure of the UK aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	Change 2016/15	Developm. 2016/ (08-15)
Structure (number)											
Total enterprises	*531*	*442*	*428*	*575*	*596*	*548*	*551*	*522*	*473*	*-9%*	*-10%*
<=5 employees	431	322	321	498	528	464	464	434	391	-10%	-10%
6-10 employees	55	70	63	43	45	52	52	60	51	-15%	-7%
>10 employees	45	50	44	34	23	32	35	28	31	11%	-15%
Employment (number)											
Total employees	*3,050*	*3,050*	*3,050*	*3,064*	*3,071*	*3,098*	*3,310*	*3,264*	*3,285*	*1%*	*5%*
Male employees	2,650	2,650	2,650	2,654	2,629	2,771	2,908				
Female employees	400	400	400	410	442	327	402				
FTE	2,660	2,660	2,660	2,671	2,566	2,686	2,761	2,734	2,817	*3%*	*5%*
Male FTE	2,310	2,310	2,310	2,316	2,233	2,459	2,498				
Female FTE	350	350	350	354	333	228	263				
Indicators											
FTE per enterprise	5.0	6.0	6.2	4.7	4.3	4.9	5.0	5.2	6.0	*14%*	*15%*
Average wage (thousand €)	25.6	21.8	27.4	23.3	34.1	35.1	35.2	42.7	36.4	*-15%*	*19%*
Labour productivity (thousand €)	81.3	85.7	51.6	84.1	62.4	107.1	123.5	69.1	101.2	*47%*	*22%*

Source: EU Member States DCF data submission

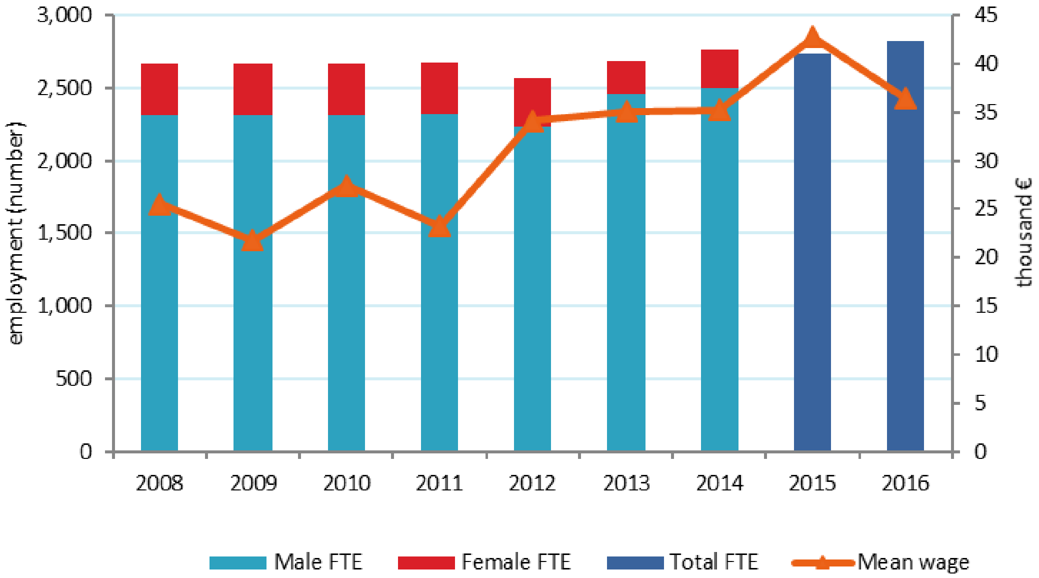

Figure 4.27.1 Income, costs, wages and labour productivity trends for the United Kingdom: 2008-2016.
Source: EU Member States DCF data submission

4.27.3 Economic performance

Economic data on UK aquaculture is summarised in Table 4.27.3. Turnover data is considered valid for the period 2008-2016, and has increased by 54%. It must be recognised that at least part of the variation between years and over time is due to changes in the GBP:€ exchange rate, and inflation.

Due to the initial lack (2008-2010), and then development (2011-2012), of the survey methodology used to gather the remaining data, only data for 2013-2016 merit consideration.

Points worthy of note from the below table (2015 and 2016 data) are:

- Due to the dominance of the salmon segment, the national combined data reflects this single segment;
- Income from turnover (=sales) contributed virtually all of total income; other income and subsidies are negligible.
- Total operating costs were 87% of total income; the major expenditures are feed, other operational costs and wages & salaries, comprising 40%, 35% and 12% of total income respectively.
- The performance indicators indicate that UK aquaculture is a profitable industry.

Table 4.27.3 Economic performance of the United Kingdom aquaculture sector: 2008-2016.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	% of total income	Change 2016-15	Development 2016/(2008-15)
Income (million €)												
Turnover	666.4	559.9	603.4	758.7	724.6	896.7	992.6	999.0	1023.2	99%	2%	32%
Other income					1.7	5.8	14.4	10.1	9.4	1%	-6%	18%
Subsidies				1.0	0.1	0.4	0.4	0.0	0.0	0%	-43%	-97%
Total income	*666.4*	*559.9*	*603.4*	*759.7*	*726.4*	*902.9*	*1007.4*	*1009.1*	*1032.7*	100%	2%	33%
Expenditures (million €)												
Wages and salaries	68.0	58.0	73.0	62.1	87.0	93.4	96.8	116.7	102.5	10%	-12%	25%
Imputed value of unpaid labour				0.1	0.5	0.8	0.5	0.7	0.5	0%	-25%	2%
Energy costs				19.1	7.1	19.0	16.0	25.2	22.9	2%	-9%	33%
Repair and maintenance				17.3	30.5	26.9	32.4	36.2	37.4	4%	3%	30%
Raw material: Feed costs				311.0	266.8	296.2	298.5	372.3	343.1	33%	-8%	11%
Raw material: Livestock costs				73.7	12.7	38.2	31.9	55.2	43.2	4%	-22%	2%
Other operational costs	450.0	332.0	466.0	113.0	249.1	234.6	287.2	330.4	299.3	29%	-9%	-3%
Total operating costs	*518.0*	*390.0*	*539.0*	*596.3*	*653.8*	*709.1*	*763.2*	*936.7*	*849.0*	82%	-9%	33%
Capital Costs (million €)												
Depreciation of capital				47.0	32.0	43.2	44.1	56.8	56.6	5%	0%	27%
Financial costs, net				58.0	5.8	8.8	9.0	10.2	10.1	1%	0%	-45%
Extraordinary costs, net				0.3	0.4	1.8	1.6					
Capital Value (million €)												
Total value of assets	286.0	182.0	255.0	550.0	612.5	644.9	598.7	880.4	868.6	84%	-1%	73%
Net Investments				35.0	107.9	63.1	77.6	63.0	89.1	9%	41%	29%
Debt				167.0	93.0	221.5	258.8	437.4	366.6	35%	-16%	56%
Input & Production (thousand tonnes)												
Raw material: Feed				260.0	266.7	217.0	234.9	282.5	296.2		5%	17%
Raw material: Livestock					16.8	2.5	6.3	13.8	10.7		-23%	8%
Performance Indicators(million €)												
Gross Value Added	216.4	227.9	137.4	224.6	160.0	287.6	341.0	189.8	286.7	28%	51%	29%
Operating cash flow	148.4	169.9	64.4	163.4	72.7	193.8	244.2	73.4	183.8	18%	150%	30%
Earning before interest and tax				116.4	40.7	150.5	200.1	16.6	127.2	12%	668%	21%
Net profit				58.4	34.9	141.7	191.1	6.4	117.1	11%	1729%	35%
Capital productivity (%)	75.7	125.2	53.9	40.8	26.1	44.6	57.0	21.6	33.0		53%	-41%
Return on Investment (%)				21.2	6.6	23.3	33.4	1.9	14.6		679%	-15%
Future Expectation Indicator (%)				-2.2	12.4	3.1	5.6	0.7	3.7		434%	-5%

Source: EU Member States DCF data submission

4.27.4 Main species produced and economic performance by segment

The UK's aquaculture industry ranks as one of the largest in the EU and is also one of the most diverse, covering nine segments: Salmon (40 enterprises), Trout (144 enterprises), Carp (55 enterprises), Other freshwater fish (17 enterprises), Other marine fish (12 enterprises), Mussels (103 enterprises), Oysters (81 enterprises), Crustaceans (5 enterprises), Other molluscs (16 enterprises). Clams are also harvested by Oyster enterprises. These sectors produced finfish and shellfish for the table (i.e., human consumption), release into angling waters, release for conservation purposes, and for the ornamental (pet) trade. Nevertheless, recorded UK aquaculture production tonnage and estimated value in 2016 continued to be attributable largely to only 3 segments: Atlantic salmon, mussels and trout. The other UK aquaculture sectors were minor in comparison, together contributing 1-2% to total tonnage and value. Although production tonnages and value are negligible in comparison to the major segments, these other segments encompassed 186 enterprises, provided employment for 588 staff and their production was valued at €12.8 million. Production of carp, other freshwater (coarse) fish and salmonids for restocking also help to support the UK's angling industry which is considered to be of economic, social and environmental importance.

Figure 4.27.2 Main species in terms of weight and value in the United Kingdom production: 2016.
Source: EU Member States DCF data submission

Estimated prices over time for the five most important species in the UK are illustrated below. Part of the variation will be due to fluctuations in the GBP-EUR exchange rate and inflation. This figure demonstrates the low unit price of mussels relative to other shellfish (oyster) and finfish. Prominent changes over time (e.g. for Sea trout = brown trout) are attributed to differences in estimation method rather than representing real changes in market price.

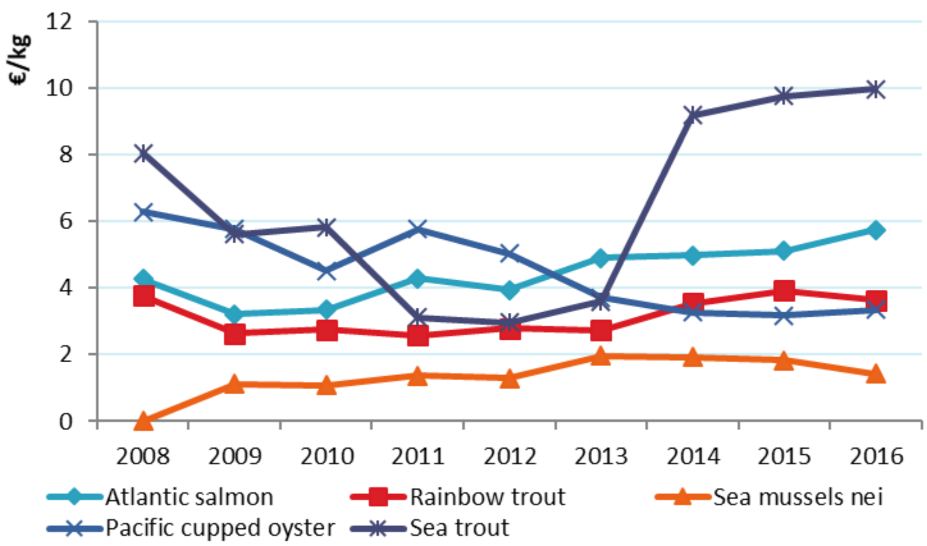

Figure 4.27.3 Average prices for the main species produced in the United Kingdom: 2008-2014.
Source: EU Member States DCF data submission. Please note 0 €/kg value for mussels in 2008 is due to classification as Blue mussels (MUS) with an estimated 1.256 €/kg.

Segment 1: Salmon combined

All UK salmon production was attributed to the EUMAP segment "other" production method (rather than separated into hatcheries and nurseries, cages, tanks and raceways, recirculation systems) because enterprises are often vertically integrated, operating across categories within the production cycle and to ensure consistency between years. (The DCF segment category previously used was "combined"). This sector therefore represents freshwater tanks (hatcheries and nurseries including recirculation aquaculture systems), freshwater net-pens (nurseries), seawater tanks (broodstock/harvest) and seawater net-pens (for ongrowing to harvest).

Salmon dominated UK aquaculture production tonnage in 2016 (163 134 tonnes; 84% of total) and value (€936.1 million; 91% of total). The bulk of salmon production is located in Scotland. A number of non-commercial sites are also included in the data, where fish are produced for release in ecological enhancement schemes.

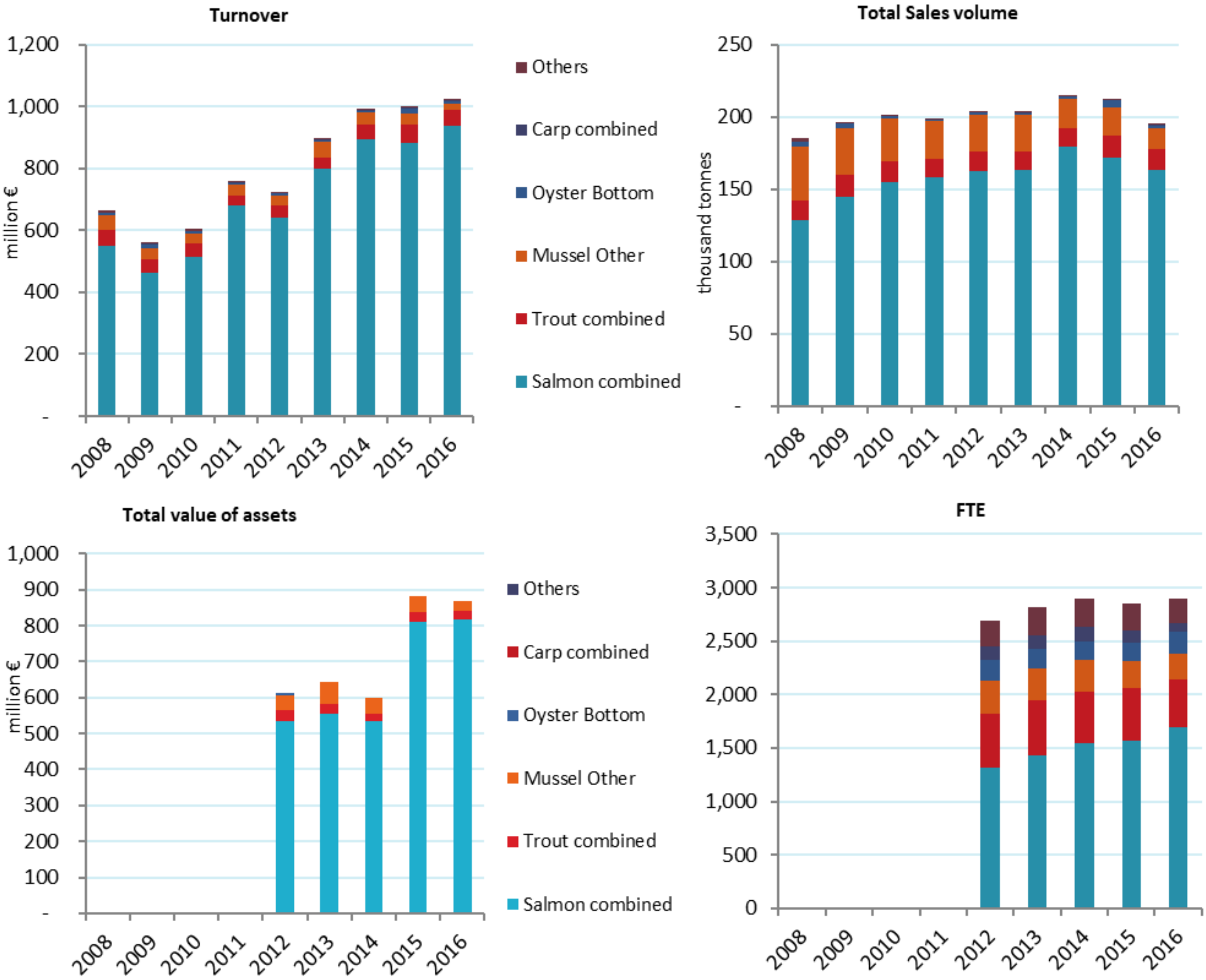

Figure 4.27.4 Structural development British aquaculture sector: 2008-2016.
Source: EU Member States DCF data submission

Segment 2: Mussel other

Mussel aquaculture in the UK uses a variety of systems (on bottom, long lines, rafts). Due to difficulties in separating production systems (companies may operate different systems and seed may be moved between system types) and to ensure consistency between years, all production within the mussel segment was categorised under the EUMAP/DCF segment “mussel other”.

Mussel was the second most important segment by tonnage (14 685 tonnes; 8% of total) but, due to a relatively low unit value, was third by value (€20.8 million; 2% of total).

Segment 3: Trout combined

All UK trout production was attributed to the “other” (previously “combined”) category (rather than separated into hatcheries and nurseries, tanks and raceways, and cages) because enterprises often operate across categories.

Although the volume of trout produced (14 173 tonnes; 7% of total) was lower than that of mussels, the trout sector had a higher imputed value (€53.4 million; 5% of total). Rainbow trout (harvested from both freshwater and marine systems) dominated the segment, but production of brown/sea trout and Arctic char continued, and hybrid trout were also reported. Trout were grown for table consumption and restocking angling waters. Although production of trout from freshwater systems dominated production, large trout produced in seawater net-pens contributed 27% of the production volume, showing a noteworthy increase in 2015 and 2016.

The relative size (turnover, production tonnage, asset value, FTE) of the UK aquaculture sectors are graphically illustrated in the figure below and highlight the dominance of salmon and its role in determining inter-annual variation in aquaculture totals.

The economic performance of the three main sectors is summarised in the table below. These data indicate that:

- the UK salmon segment is typically profitable (apart from 2015);
- the UK mussel segment is typically profitable (apart from 2016);
- the UK trout segment is struggling, operating around a break-even level. This interpretation agrees with feedback from UK trout farmers.

Table 4.27.4 Economic performance of main the United Kingdom aquaculture segments: 2008-2016 (in million €).

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	% of total income	Change 2016/15	Development 2016/(2008-15)
Salmon combined												
Total income	549.7	464.6	515.7	678.6	642.7	803.8	904.7	886.4	942.8	100%	6%	38%
Gross Value Added					124.1	241.2	298.7	135.9	254.0	27%	87%	27%
Operating cash flow					54.5	166.4	216.3	38.6	169.1	18%	338%	42%
Earning before interest and tax					28.4	134.2	177.2	-11.0	117.9	13%	1168%	43%
Net profit					27.7	126.8	169.2	-20.1	108.7	12%	641%	43%
Total sales volume (thousand tonnes)	128.7	144.7	154.6	158.3	162.5	163.5	179.4	172.1	163.1		-5%	3%
Mussel Other												
Total income	47.0	35.8	32.8	35.8	34.3	53.5	40.1	35.6	21.7	100%	-39%	-45%
Gross Value Added					24.3	26.8	19.8	19.5	8.6	40%	-56%	-62%
Operating cash flow					18.1	14.7	13.6	12.4	0.9	4%	-93%	-94%
Earning before interest and tax					14.2	9.4	9.7	7.6	-2.9	-13%	-138%	-128%
Net profit					10.1	9.0	9.5	7.2	-3.1	-14%	-144%	-135%
Total sales volume (thousand tonnes)	37.5	31.9	30.2	26.2	26.0	25.0	20.0	19.3	14.7		-24%	-46%
Trout combined												
Total income	52.5	42.6	40.8	33.1	37.2	35.4	50.3	65.8	55.4	100%	-16%	24%
Gross Value Added					1.8	9.4	10.2	13.0	11.2	20%	-14%	30%
Operating cash flow					-7.1	2.6	1.9	1.0	0.9	2%	-16%	326%
Earning before interest and tax					-8.6	-3.1	0.8	-1.3	-0.7	-1%	42%	76%
Net profit					-9.4	-4.1	0.1	-2.0	-1.4	-3%	30%	64%
Total sales volume (thousand tonnes)	13.5	15.5	14.2	12.7	13.2	12.8	13.0	15.2	14.2		-7%	3%

Source: EU Member States DCF data submission

In relation to operating costs (Figure below):

- Salmon: the main costs were for feed (39% of total), other operational costs (34%) and labour (18%).
- Trout: the main costs were similarly feed (37% of total), other operational costs (24%), labour (18%), with livestock costs (16%) also being significant. The greater contribution of livestock costs for trout than salmon reflects less vertical integration.
- Mussels: the main costs differed from finfish being other operational costs (25%), labour (30%), livestock costs (17%) and consumption of fixed capital (15%).

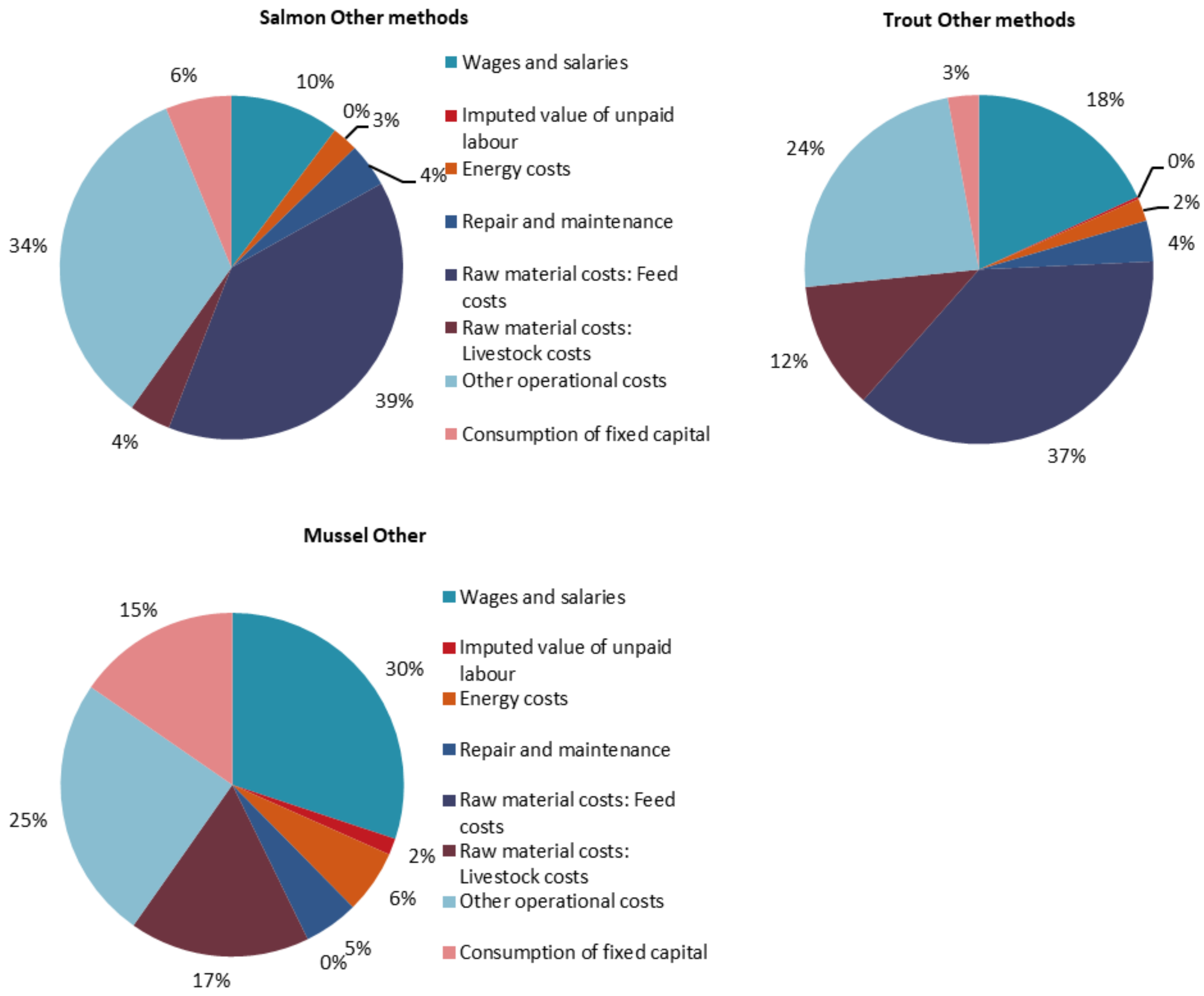

Figure 4.27.5 Cost structure of the main segments in the United Kingdom: 2016.
Source: EU Member States DCF data submission

4.27.5 Trends and triggers

Current production trends and main drivers

UK aquaculture production is dominated by salmon production which is focussed in Scotland due to the suitable climate and sheltered sea lochs for on-growing. Following a period (2008-2014) of annual increases in salmon production volume reaching its highest ever level in 2014, production volume decreased in 2015 and again in 2016. This is thought to be due to decreases in both percentage harvest and mean weight of fish at harvest[19]. Both factors are likely to be attributable, at least in part, to disease (e.g. amoebic gill disease) increasing mortality, decreasing growth and prompting early harvest. Harmful algal blooms and jellyfish swarms have also been cited as explanations for a reduced Scottish salmon harvest in 2015. The decrease in production volume in 2016 was nevertheless offset by an increase in unit value (€/tonne), so sales income in 2016 reached a new peak. The increase in unit value in 2016 was associated with an all-time high in world prices due to strong demand and reduced supply[20].

The downturn in production volume of salmon (2015-16) has proved temporary, with production in 2017 reported to have increased sharply by 16.5% to a new all-time peak (189 707 tonnes)[21].

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[19] https://beta.gov.scot/publications/scottish-fish-farm-production-survey-2016/
[20] http://www.hie.co.uk/regional-information/economic-reports-and-research/archive/value-of-aquaculture-2017.html
[21] https://www.gov.scot/Publications/2018/10/4747/downloads

This was associated with increases in survival and weight at harvest. However, another decrease in production volume has been forecast for 2018.

Future prospects for the Scottish salmon industry depend upon a combination of industry, policy and market factors[22]:

- Consolidation to fewer larger companies operating more efficiently in fewer (but larger) sites enabling increased productivity per employee.
- Ongrowing survival, growth and size at harvest.
- The supply of ova. Currently the industry is dependent on foreign sources (90% imported)[23]. For continuity, this international trade will need to be maintained post-Brexit.
- Support from the Scottish Government which recognises the segment as helping to sustain economic growth in the rural and coastal communities and support (up- and down-stream) jobs across Scotland. In 2014, the "*catalytic effect of that added income across the economy*" was estimated to contribute €1.7 billion turnover and 8 000 jobs to Scotland[24].
- An ongoing Scottish Government inquiry into the environmental impacts of salmon farming[25], and any resulting tightening of policy and regulation.
- Global salmon prices which are currently at an all-time high due to strong demand.
- The UK market (being the largest market for UK salmon) with domestically produced fish attracting a premium price. Farmed salmon are also imported, and this supply may be affected by Brexit.
- The export market for UK salmon (currently focussed on USA, France and China) and any impact of Brexit.

The bulk of UK salmon production is certified under various standards that address environmental impacts, product quality, traceability and fish welfare. The industry also operates to the Code of Good Practice for Scottish Finfish Aquaculture. The salmon industry is also represented by active trade associations, e.g. Scottish Salmon Producers' Organisation.

Salmon farming continues to mature and further technological improvements (e.g. recirculation aquaculture systems for smolt production, multi-valent vaccines) enable more efficient production, alongside increasingly larger systems. The multinational nature of salmon farming facilitates the transfer of developments between countries.

Cleaner fish are continuing to become an important segment of UK aquaculture, as a biological control for the perpetual health (and environmental) issue of sea-lice. Additional new methods for sea-lice control are also being implemented (net-pen "skirts", warm-water and mechanical removal techniques) as well as medicinal treatments, area management agreements and fallowing making up integrated health management.

Challenges for the salmon industry remain:

- **Environmental pressures**. Concerns continue to be expressed that salmon farming may have negative impacts on wild salmonid stocks, in particular escapees reducing fitness through genetic introgression, and transmission of sea-lice from farmed stocks compromising the survival of wild smolts. Publication of data on escapes and lice counts has been introduced to aid transparency, and schemes have been introduced to reduce escapes (through containment standards).

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[22] http://www.hie.co.uk/regional-information/economic-reports-and-research/archive/value-of-aquaculture-2017.html
[23] https://www.gov.scot/Resource/0054/00541860.pdf
[24] https://www.researchgate.net/profile/Karen_Alexander5/publication/263672770_An_Assessment_of_the_Benefits_to_Scotland_of_Aquaculture_Prepared_for_Marine_Scotland_and_Highlands_and_Islands_Enterprise/links/02e7e53ba61c5a7203000000/An-Assessment-of-the-Benefits-to-Scotland-of-Aquaculture-Prepared-for-Marine-Scotland-and-Highlands-and-Islands-Enterprise.pdf
[25] http://www.parliament.scot/parliamentarybusiness/CurrentCommittees/107588.aspx

- **Disease pressures**: New diseases continue to emerge, for example Amoebic Gill Disease (AGD), and existing pathogen problems can escalate e.g. due to resistance to chemotherapeutants developing in sea-lice. Disease compromises production (growth and survival) and controls add additional costs (e.g. freshwater bathing for AGD).
- **Plankton issues (harmful algal blooms and jellyfish swarms):** It is difficult to determine whether such events are becoming more frequent and the potential role of climate change. Research is ongoing to use remote monitoring to provide advance warnings to enable interventions to protect stocks.
- **Smolt supply**: Salmon on-growing is dependent upon a sufficient supply of good quality smolt. The industry is continuing to invest in large centralised recirculation aquaculture systems (RAS) for smolt production reducing dependence on freshwater availability and the vagaries of climate.
- **Seawater site availability**: The availability of additional near-shore sheltered sites is perceived to be limiting expansion of net-pen capacity. The industry is gradually moving to more exposed sites using larger and more robust systems. An additional strategy being investigated is growing of larger size smolt, so the time in seawater net-pens is reduced, thereby enabling more frequent harvests. This strategy requires a greater freshwater capacity, which is in part being met via the introduction of RAS.

UK production of mussels has declined for the eighth successive year. This decline cannot readily be explained given the apparent profitability of the mussel segment. The trend is expected to be reversed in the coming years as new large long-line sites start harvesting. Ongoing challenges for the mussel industry include spat supply, sanitary and phytosanitary controls, and classification of waters.

UK production of trout remains largely static, with a minor increase in production in 2015-16 due to increased on-growing in seawater using salmon systems. Table trout have to compete with salmon; it is unlikely that the production of portion size fish will increase, but production of larger seawater trout (grown in Scotland using salmon net-pen systems) has doubled from 2013-14 to 2015-16. Freshwater trout are produced for both the table market and restocking angling waters, the latter production commanding higher unit prices. There is anecdotal evidence that demand for restocking trout is declining due to decreasing interest in trout angling. The decline in freshwater production is explained by the marginal profitability. There are further anecdotal accounts of freshwater on-growers diverging from portion size to larger trout due to a higher unit value.

Market structure

UK aquaculture businesses generally operate independently, although some shellfish producers may form co-operatives.

The three main segments each have separate trade bodies (producer organisations) which represent their interests on political, regulatory, media and technical issues.

- the Scottish Salmon Producers Organisation (SSPO) encompasses most of Scottish salmon production. Membership comprises companies involved in the freshwater and marine stages of salmon production.
- The British Trout Association represents 80% of UK trout production, and members include trout farmers and feed suppliers.
- The Shellfish Association of Great Britain whose members include shellfish farmers, fishermen, fishermen's Associations, processors, commercial traders and retail companies.

There are also a number of smaller regional/sector trade bodies in the UK (e.g. Association of Scottish Shellfish Growers, Welsh Aquaculture Producers’ Association, British Marine Finfish Association, Scottish Shellfish Marketing Group, Shetland Aquaculture).

A number of production standards operate in UK aquaculture (e.g. the Code of Good Practice for Scottish FinFish Aquaculture, Label Rouge, RSPCA Assured (previously Freedom Food), Quality Trout UK). In addition, most retailers have Codes of Practice and/or standards. Interest in organic aquaculture remains limited within the UK – only 2% of salmon production was certified as organic, although the previous trend for decreasing organic production (both number of sites and production) has plateaued.

Seafish (i.e. the Sea Fish Industry Authority) is a UK non-departmental public body "*supporting the seafood industry for a sustainable, profitable future*" funded by a levy on the seafood industry. In recent years Seafish, recognising that aquaculture products (both domestic and imported) play an important role in seafood supply, have taken a more active role in providing information on, and promoting the development of UK aquaculture.

Issues of special interest

Issues of relevance to UK aquaculture include:

- Scotland's Aquaculture Database and website (http://aquaculture.scotland.gov.uk/) is now established making regulatory data collected by SEPA, Marine Scotland, Food Standards Agency Scotland (FSAS) and The Crown Estate publicly available.
- The publication by the SSPO of monthly figures for member farms of 1) adult female lice (Average per fish) counts and 2) stock mortality rates.
- EU-exit, more commonly known as Brexit.

Outlook for future production trends

If the trends for production volume apparent from the long-term DCF datasets continue, it can be expected that:

- salmon production will increase, albeit recognising the key drivers above
- trout production will remain static – reducing freshwater production being offset by increased seawater production
- mussel production will continue to decline, unless new off-bottom sites fulfil their promise

For the minor species:

- Pacific oyster production peaked in 2016, with production showing a strong upward trajectory.
- Native (European flat) oyster production hit a 25-year low in 2016, continuing the long-term negative trend
- Production of cleaner fish (Ballan wrasse and lumpsucker) will continue to increase to meet demand
- Production of macroalgae is being trialled in the UK on a pilot/research scale.

A significant portion of UK aquaculture production is exported (salmon, mussel) rather than being consumed domestically. It is unclear how potential changes in trade agreements (for both imports and exports) following Brexit will affect the domestic and export markets for UK aquaculture products. EU membership also enables access to EMFF funding for aquaculture development. Although salmon enterprises are typically too large to access such funding, its loss may affect other segments of the industry unless replacement vehicles are introduced.

4.27.6 Data Coverage and Data Quality

Data quality

Under aquatic animal health regulations, all aquaculture production businesses (APBs) are required to be authorised by the regional competent authorities for fish and shellfish health. There are three separate bodies covering England and Wales, Scotland, and Northern Ireland, which have a full overview of farm sites and businesses. All APBs are included in annual censuses which collect information on species, production volumes, systems and employment with coverage approaching 100%. Census data were provided direct from the administrations and summed to provide UK totals. Production volumes (tonnes) were therefore fully recorded and can be considered precise.

Typical farm gate prices (GBP/tonne) were based on estimates by experts and producer organisations. Turnover was imputed from volume x estimated farm gate price. All GBP values were converted to EUR values using annual conversion factors from Eurostat. Turnovers are therefore estimates and can be considered good.

Statistics on employment were recorded within the censuses of enterprises:

- Data on numbers of enterprises (with respect to number of employees) can be considered fully recorded and precise.
- Numbers of full-time and part-time employees are recorded across the UK. The total number of employees was therefore fully recorded and can be considered exact.
- Data on FTE was only collected for England and Wales. For Scotland and Northern Ireland, an FTE was estimated for all part-time staff. Total FTEs are therefore estimates which can be considered good
- All other economic/input data for 2015 and 2016 were collected by a targeted questionnaire survey (salmon – all enterprises; trout & mussel – main producers). The response rate varied between segments: salmon 29%, trout 65%, mussel 24%. Although responses were only received from 10% of UK aquaculture enterprises, these represented ca 42% of UK production volume, value and employment.

Data availability

Data for the aquaculture sector is published annually in an aggregated form. Scottish aquaculture statistics are available from

http://www.gov.scot/Topics/marine/Publications/FRS-Reports/FRS-Surveys,

and the collated UK statistics from Eurostat and JRC

Confidentiality

Reporting of a single segment within each species grouping ensures that each segment represents >5 enterprises.

Differences in DCF data compared with other official data sources

The volume and value data submitted to DCF corresponds with that submitted to FAO and EUROSTAT as it is derived from the same censuses. However, small differences occur because:

- Data is combined differently, e.g. within Eurostat rainbow trout and brown/sea trout production is allotted to freshwater and seawater production, but under DCF all trout is reported under freshwater.
- For Eurostat, only data on production for human consumption are included; DCF data includes all reported aquaculture, i.e., the additional production for angling and cleaner fish (i.e., functional species).
- FAO data may include estimates. FAO request data before it is available (being collected and collated under EC regulations for submission in Year+2). Data for the previous year is therefore necessarily provided as interim estimates and revised data submitted subsequently when available. FAO data may not reflect the updated submissions.

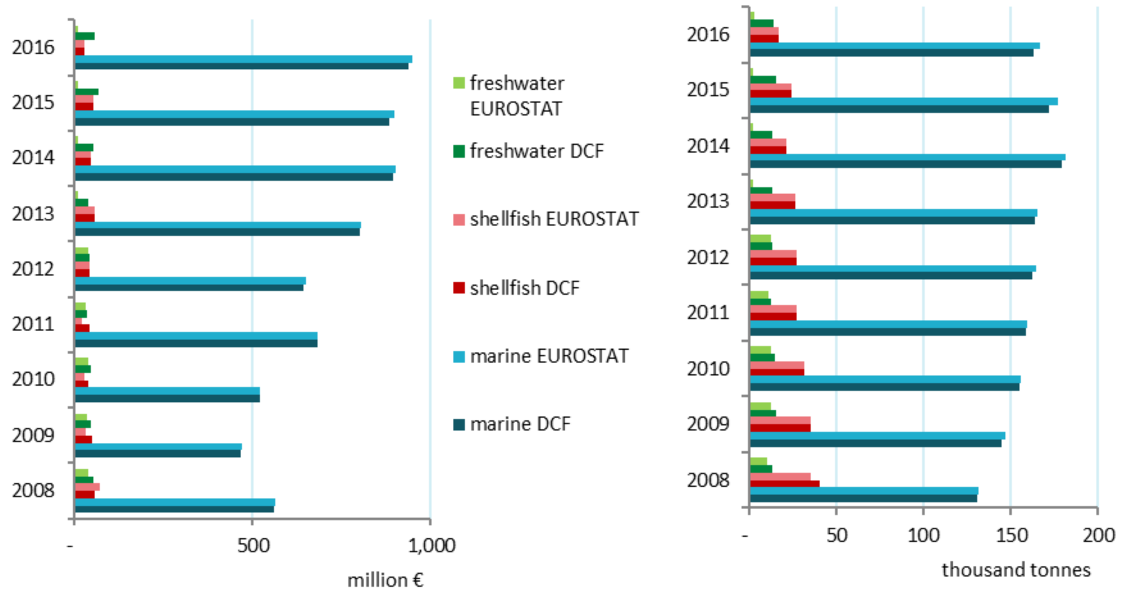


Figure 4.27.6 Comparison of DCF data with EUROSTAT data for the United Kingdom: 2008-2016
Source: EU Member States DCF data submission

4.27.7 Environmental data

Under EUMAP, Member States were required to conduct pilot data collection exercises in 2018 for medicine use and mortality. The UK submitted SEPA[26] data for 2015 and 2016, for Scottish finfish seawater net-pen sites.

[26] https://www.sepa.org.uk/; http://aquaculture.scotland.gov.uk/data/fish_farms_monthly_biomass_and_treatment_reports.aspx; http://apps.sepa.org.uk/spripa/Search/ByPollutant/Criteria.aspx

5 SPECIAL CHAPTER

5.1 Description on Multi Annual Plans

The reform of the Common Fishery Policy (CFP) encourages the promotion of aquaculture through a cooperation process based on multiannual strategic plans to be developed by the Member States. The Guidelines for the elaboration of these plans were provided in the Communication from the Commission COM(2013) 229 Final, Strategic Guidelines for the sustainable development of EU aquaculture. The main goal is to contribute to decrease the EU dependence on seafood imports to satisfy demand in a sustainable manner.

The strategy is based in four main pillars, which were further specified and developed by the Member States in their corresponding strategic plans. These pillars are:

a) Simplify administrative procedures
b) Securing sustainable development and growth of aquaculture through coordinated spatial planning
c) Enhance the competitiveness of EU aquaculture
d) Promoting a level playing field for EU operators

Every Member State was requested to perform the assessment of the national situation and consider the policies and actions to be taken. Aquaculture growth goals in volume and value during the execution of the plan must be indicated, as well as quantified targets and indicators, when possible, for each of the four pillars. The plans were developed by each Member States between 2014 and 2015.

- Regarding the first pillar, most Member States agreed that the complicated administrative procedures can be a barrier for development in the aquaculture sector (See also "The economic performance of the EU aquaculture sector (STECF14-18)"). The creation of Inter-Ministry coordination groups, advisory boards involving stakeholders and simplification of the formalities when applying for extension of existing or new production licenses are among the proposed actions to be taken.
- There is a need to implement and improve the use of spatial planning. This was acknowledged by all Member States. The use of spatial planning can potentially support the administrative decision making processes and this element action seems to be present in all the strategic plans.
- Similar approaches across Member States appear when facing the third pillar. Most propose research and innovation, cooperation among stakeholders, environmental sustainability and market diversification as improvements enhancing the competitiveness of EU aquaculture.
- The implementation of the fourth pillar focused on exploiting competitive advantages due to high quality, health and environmental standards. Certifications played a relevant role in this pillar and were proposed, under different schemes, by most countries. Marketing campaigns are also present in most of the strategic plans.
- Finally, in the field of best practices, the development of codes of conduct, reduction of environmental impact, along with the more specific certifications, appear as the most common proposals among Member States.

5.2 Assessing the potential growth and whether goals will be achieved in 2023?

The following tables show the growth expectations and current achievements using the volumes and values presented in the Multiannual Strategic Plans for each Member State (https://ec.europa.eu/fisheries/cfp/aquaculture/multiannual-national-plans_en). The first table documents the volume of the base year and expected growth in the end of the programme period (2020-2023). To align the actual achievements with number in this report it should be noted that the actual growth in percentage reported here is the achieved growth reported under the DCF from 2013 until 2016. The reason for this is that some countries have data coverage that is either much higher or lower in the national programs than what is reported under the DCF. Furthermore, it should also be noted that 2013 is a rather weak year in terms of production, because of a production decline in most of the five largest aquaculture producers in Europe in this year, which influences on the production achievements for 2016.

Table 5.1: Expectations and achievement in volume

Member States	Base year	End year	2013 volume (national programme)	2020 volume (national programme)	% change Base-End	% change Base-2016
AUT	2013	2020	3,100	5,500	77	8
BEL	2013	2022	332	1,032	211	-79
BGR	2013	2020	14,000	200,00	43	53
CYP	2013	2023	5,339	6,332	19	25
CZE	2013	2020	20,000	20,000	0	8
DEU	2013	2020	26,500	52,000	96	62
DNK	2013	2020	44,000	55,000	25	4
ESP	2013	2020	267,000	320,000	20	27
EST	2013	2020	N/a	N/a		34
FIN	2013	2020	13,700	20,000	46	9
FRA	2013	2020	218,000	265,000	22	-3
GBR	2013	2020	205,000	254,000	24	-4
GRC*	2013	2020	114,000	170,000	49	8
HRV	2013	2020	13,916	24,050	73	54
HUN	2013	2023	21,500	27,000	26	9
IRL	2013	2020	36,700	81,700	123	27
ITA	2013	2025	140,879	206,854	47	30
LTU	2013	2022	3,845	6,400	66	4
LVA	2013	2020	644	2,256	250	23
MLT	2013	2020	8,606	10,500	22	50
NLD	2013	2023	N/a	N/a		21
POL	2013	2020	40,000	61,000	53	9
PRT	2013	2020	10,317	35,000	239	44
ROU	2013	2020	10,146	36,000	255	23
SVK	2013	2020	N/a	N/a		96
SVN	2012	2020	1,155	2,420	110	77
SWE	2013	2020	12,500	25,000	100	16
Total			**1,231,179**	**1,707,044**	**39**	**13**

* The production volumes for Greece have been obtained from FAO due to reporting issues (See Greece national chapter).

From table 5.1 it can be seen that most Member States have a positive contribution to the overall volume produced in EU. In total, the production volume increased by 13% based on DCF data. However, it should be kept in mind that 2013 was weak base year. This was particular true for the mussel production within some of the biggest aquaculture producing countries, which contribute to the positive result.

Figure 5.1 below shows the current and expected evolution compared with the most recent forecasts for aquaculture production within the EU. The black line illustrates the development of the production in EU-28 based on DCF data. The forecast based on the National Multiannual Strategic Plans illustrated with the dark grey line "MS National programmes" show an increase of less than 5% each year. From 2013 and until 2016 it seems that the production goals are just on target for the first three years. However, the production is still below the volumes produced from 2008 to 2010. As such, it seems that the real challenge of reaching the national goals of the strategic plans will be in the coming years where an actual increase in the overall production in the EU should be reached to comply with national programmes.

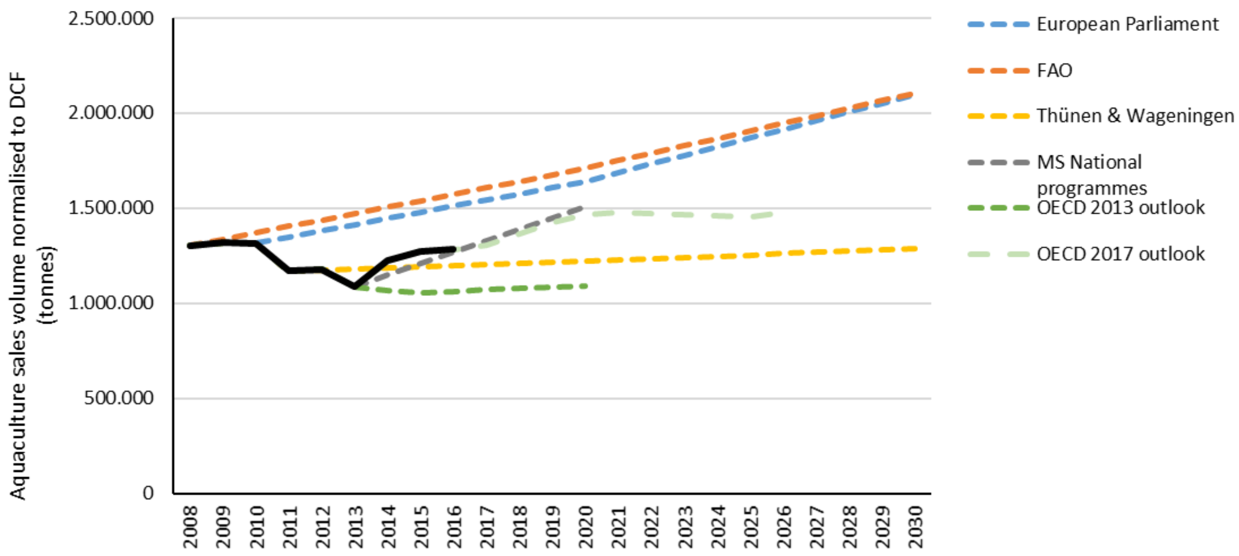


Figure 5.1: Actual development in production volume (DCF) and future projections for production in EU.

The projections from the European Parliament and FAO seems to be far too optimistic compared to the production achieved in the previous period (2007-2014) and the actual production realized until 2016. The projection from the Thünen Institute & Wageningen seems more conservative, but also more in line with the actual production achieved. Once again, the year in which the projection was made is critically important as the growth rate in EU aquaculture production (the slope of the line) is lower from the European Parliament and FAO reports than from the MS national programmes.

Table 5.2 shows the value of production of the base year and expected growth in the end of the programme period (2020-2023). Again, to align the actual achievements with number in this report it should be noted that the actual growth in percentage reported here is the achieved growth reported under the DCF from 2013 until 2016. It has been more difficult to retrieve an explicit value target from the National programs.

From table 5.2 it can be seen that most Member States have a positive contribution to the overall value of production in EU. In total, the value of production increased by 19 % in nominal prices and 18% in real prices based on DCF data. Here the production of mussels is a key driver as it contributes significantly to production quantity but far less of the value. One of the positive drivers here has been the salmon price. The positive influence of the increasing prices can for example be seen in the UK where the quantity has been decreasing however the value have still been increasing from 2013 to 2016.

Table 5.2: Expectations and achievement in value

Member States	Base year	End year	2013 value (national programme)	2020 value (national programme)	% change Base-End	% change Nominal 2013-2016	% change Real 2013-2016
AUT	2013	2020	N/a	N/a		22	18
BEL	2013	2022	4,500,000	11,500,000	156	-56	-58
BGR	2013	2020	N/a	N/a		43	49
CYP	2013	2023	29,200,000	34,500,000	18	30	34
CZE	2013	2020	42,500,000	42,500,000	0	6	4
DEU	2013	2020	N/a	N/a		24	22
DNK	2013	2020	134,000,000	167,500,000	25	14	14
ESP	2013	2020	436,000,000	550,000,000	26	27	29
EST	2013	2020	N/a	N/a		37	35
FIN	2013	2020	60,000,000	100,000,000	67	10	9
FRA	2013	2020	682,000,000	1,025,000,000	50	-7	-8
GBR	2013	2020	782,000,000	958,000,000	23	14	12
GRC	2013	2020	N/a	N/a		57	61
HRV	2013	2020	78,000,000	181,000,000	132	50	51
HUN	2013	2023	N/a	N/a		21	21
IRL	2013	2020	138,000,000	307,000,000	122	42	42
ITA	2013	2025	393,000,000	641,000,000	63	16	15
LTU	2013	2022	8,900,000	18,800,000	111	29	28
LVA	2013	2020	N/a	N/a		30	28
MLT	2013	2020	101,000,000	120,000,000	19	55	50
NLD	2013	2023	93,000,000	95,800,000	3	-24	-24
POL	2013	2020	N/a	N/a		30	31
PRT	2013	2020	N/a	N/a		62	61
ROU	2013	2020	N/a	N/a		37	37
SVK	2013	2020	N/a	N/a		60	62
SVN	2012	2020	3,100,000	4,900,000	58	40	40
SWE	2013	2020	N/a	N/a		19	16
Total	**2013**	**2020**	**2,851,200,000**	**4,090,000,000**	**43**	**19**	**18**

5.3 Conclusion

The Member States prepared their Multiannual Strategic Plans in accordance with the guidelines designed by the Commission covering topics within the four pillars in the extent as the National conditions required. More than half of the projected actions are under execution in almost all countries and all points towards that most of the proposed actions will be concluded in time for 2020 and 2023. Improvements in the industry performance should begin to be noted since the experts agreed that the proposed actions will have positive impacts on the industry. However, it seems that there is no clear link across the many proposed actions and the actual production goals set for each country, or how an increase in the production can be achieved from the proposed measures and actions taken.

All countries have ongoing actions in one or all the strategic pillars, but only few countries have already overcome or are close to achieve the production goals. In many of these cases the evolution in production can be better justified by causes outside the strategic plan actions, such as, adverse environmental conditions. Furthermore, the evolution in production when looking by main segments significantly differs from projections even in those countries that have grown more than expected. The projected quantities and values appear to be too optimistic or even unrealistic in many cases. Despite of the above reserves, the design and implementation of the Multiannual Strategic Plans is a step forward in the lifetime of modern EU aquaculture and a success in coordination of the different stakeholders across countries towards a common goal and strategy. In the future, the linkages across operational actions and production goals and assessment indicators should be better aligned and specified. Currently, a revision of the production goals and the methodologies for estimating these goals, in connection with the actions taken, would be worth taking into consideration. Here it should be noted that the aquaculture sector is based on a biological production and therefore exposed to large variation due to changes in the environmental conditions. This can greatly influence both base year and also the outcome in the end year of the period, which should be taken into account when evaluating if the goals have been achieved.

5.4 National assessments

5.4.1 Bulgaria

1: Overall goals for the national program

The main goal in the Bulgarian multiannual national plan is related to the Production which should reach 20 000 tonnes by 2020 (43% increase) and to increase with 34.5% in volume the freshwater fish farming by 2020. The other important goals are environmental, spatial planning and minimization of the administrative burdens.

2: Planned measures and actions:

It is important to note that the exceeding of the target of 20 000 tonnes should not be a result of mechanical increase of the production output, but should be achieved through the implementation of policies and measures for structuring and restructuring of the sector. Achieving this objective should be accomplished by supporting the farms, implementation of systems to improve the production performance of water basins and water recirculation. One of the priorities will be financing the farms with an annual production of over 100 tonnes of production.

To reach the environmental goal, which is to reduce the risk of excessive eutrophication causing extremely negative consequences for the environment and humans, production limits should be implemented for each farm. Introduction of a coordinated spatial planning, including marine spatial planning at the sea-basin level, is necessary to ensure the potential needs of aquaculture sector. Minimization of administrative burdens and simplification of administrative procedures should be covered through a reduction in the duration of the registration process to 7 months. In order to reduce the administrative burden, there is a measure to create the Advisory Board to the Minister of Agriculture and Food.

3: Implementation and achievement

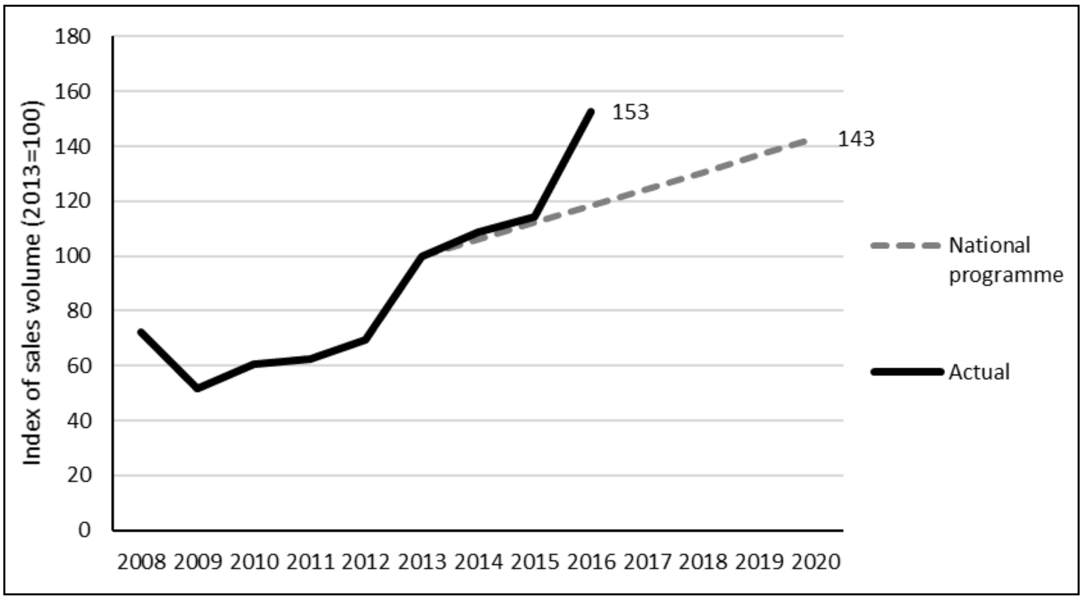
Until 2018 a part of the plan has been implemented and goals have been achieved as follow:

To ensure the environmental protection Bulgaria changed the legislation and approved an Ordinance on the content of the technological description and the aquaculture production scheme where the production limits for every farm should be set before the registration;

Bulgaria implemented measure for development of the sub-sector into the Regional Development Plans in order to ensure enough space for aquaculture, especially in the marine region. As a result of this measure, aquaculture zones are defined both in inland waters and the Black Sea;

For the minimization of administrative burdens Bulgaria implemented set of changes in the legislation with which simplified the administrative procedures in general and the period for registration of aquaculture farm was reduced to 6 months. Within 14 days from the filling of the application under Art. 25a, para 1 from Fisheries and Aquaculture Act, enterprise shall be entered in the register and the final registration certificate shall be issued, if there are no incompleteness or inaccuracies in the submitted documents.

The potential reaching of the main goal until 2023 of the Bulgarian multiannual national plan to increase the production seems to be reachable on the base of increasing of the percentage year by year. It should be noted that the data provided for the preparation of the plan was regarding the production of the aquaculture sector and in DCF it is about the volume of the sales. In regards to this, it is not possible to assess the status of the implementation of goal when it comes to the volume of the production.



5.4.2 Croatia

1: Overall goals for the national program

The multiannual National Strategic Plan for Aquaculture Development 2014-2020 (NSPA) aims to improve the social and business environment in aquaculture development, increase the national consumption of aquaculture products, and increase the employment in the aquaculture industry, while furthering the development of local communities.

By the end of 2020, the total production in aquaculture is expected to reach 24,050 tonnes, while adhering to the principles of economic, social and environmental sustainability. Additionally, in accordance with the European Commission Strategic Guidelines for Sustainable Development of EU Aquaculture, the NSPA emphasises the following objectives: simplifying administrative procedures, ensuring sustainable development and growth through coordinated spatial planning and ensuring necessary aquaculture locations, increasing competitiveness, especially by connecting the scientific community and the sector, and creating a fair market competition.

General priorities of marine and freshwater aquaculture in the 2014-2020 period may be categorized into the 7 topics: 1. Legal framework and administration, 2. Spatial placement of the activity and spatial planning; 3. Environment and nature; 4. Health of organisms in farming; 5. Market and competitiveness; 6. Perception and communication; 7. Education and employment with following priorities.

2: Planned measures and actions:

In the realization of general objectives of the Europe 2020 Strategy, the implementation of NSPA, in accordance with the provisions of the Common Strategic Framework, shall contribute to the achievement of thematic objectives (TO) 3, 4, 6, 8 and 11. Activities and measures related to specific objectives so as links to National OP are in detail described in NSPA.

The financing of measures referred to in NSPA is performed with measures related to EU Priority 2 (ensuring an ecologically sustainable, efficient, innovative, competitive and knowledge-based aquaculture), measures related to EU Priority 5 (ensuring market promotion and processing of fishery and aquaculture products) and measures related to EU Priority 6 (ensuring the implementation of an integrated maritime policy).

Investments in aquaculture will support resource-efficiency and foster conversion to eco-management schemes and ecological aquaculture as well as support the provision of environmental services.

In addition to funds from the EMFF, the use of other ESI funds is envisaged (primarily EFRD and EAFRD) and partially Horizon 2020 to finance a part of the activities aimed at achieving NSPA objectives.

3: Implementation and achievement

Croatia has already implemented the basic principles of marine spatial planning and zoning in most counties, which has reduced the administrative burden. Good practice implemented in some counties shall project to other areas, and this issue shall be addressed horizontally at the national level.

Legislative changes are recent, as the new Act on Aquaculture has been adopted and new regulations for aquaculture are in preparation. Regarding EMFF financing, both *Measures related to EU Priority 2* (Productive investments in aquaculture, Increasing the potential of aquaculture sites, Conversion to eco-management and audit schemes and organic aquaculture, Aquaculture providing environmental services, Public health measures, Animal health and welfare measures, Aquaculture stock insurance) so as *Measures related to EU Priority 5* (Production and marketing plans, Marketing measures, Processing of fisheries and aquaculture products) are in preparation or already in progress. Production value increased from €78 million in 2012 to €108 million in 2016 while production volume increased from 14 000 tonnes to 17 300 tonnes in the same period, followed by steady increase of national FTE. Overall, although growth in production does not follow the objective completely, the majority of the objectives are on track to being achieved by 2020 or by the end of operational period, 2023.

5.4.3 Denmark

1: Overall goals for the national program

According to the Danish national plan the production goal has to be raised by 25% from 44 000 tonnes in 2012 to 55 000 tonnes and the value accordingly with 25% in 2020. This has to be helped trough means of simplifying administrative procedures, enhancing competitiveness and coordinating spatial planning. Furthermore, the Danish national plan identifies a number of examples of best practice covering different species and production systems including:

- Reducing environmental impacts: e.g. improving of recirculation technology focusing both on an environmental friendly and an economically efficient production system for a future sustainable aquaculture production
- Integrated Multi-Trophic Aquaculture: e.g. development of efficient systems of mussels and seaweed aquaculture systems to reduce the environmental impacts of finfish farming.

2: Planned measures and actions:

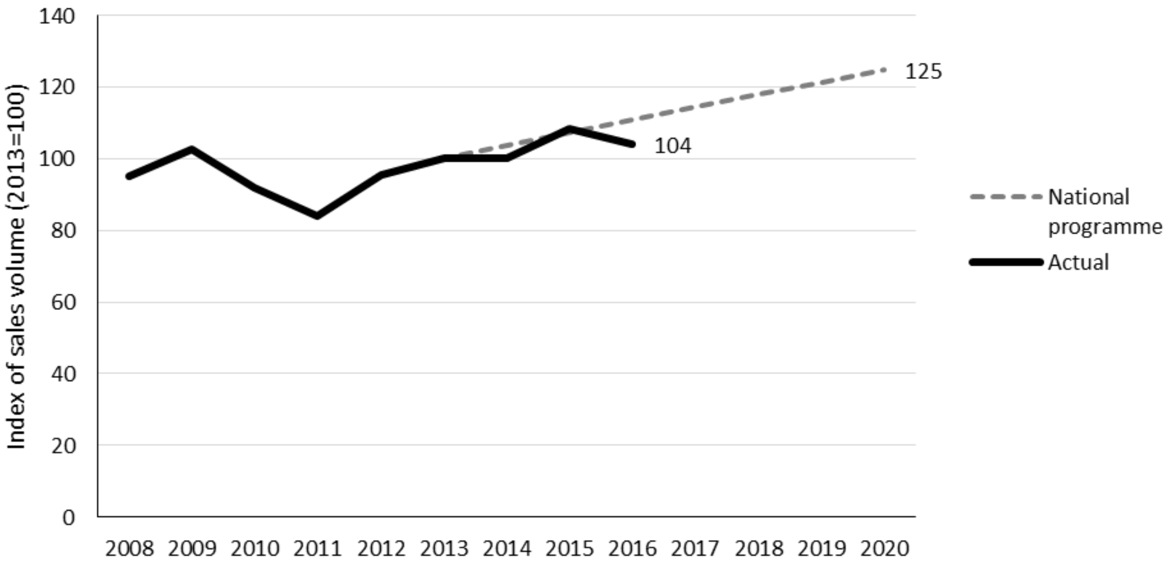
The Danish national plan wants to simplify the administrative procedures by improve communication, identify administrative barriers, and where possible simplify rules and regulations. Furthermore, the plan focuses on making it easier to test and use new technology. Guidelines for simplification of procedures will be drawn up for freshwater, marine, and multi-trophic systems. National and regional spatial plans for both freshwater and marine aquaculture should be made, and proactively allocate aquaculture production areas that are prioritized for development. Enhanced competitiveness by supporting development and promotion of new species, post-harvest product innovation and marketing and by help certifying organic production (10% increase), environmental and social responsible e.g. ASC

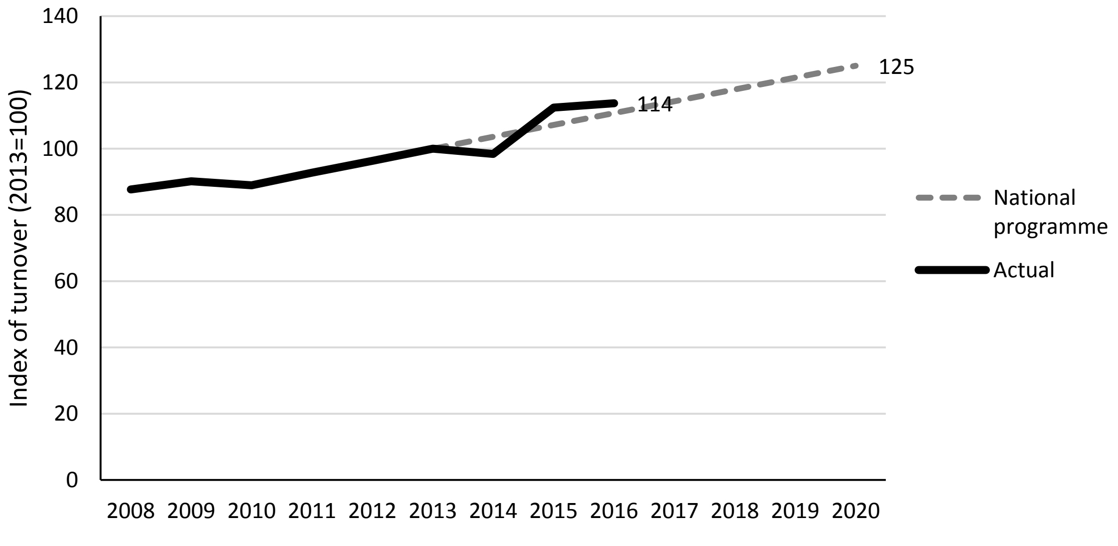
3: Implementation and achievement

Spatial plans for marine aquaculture growth has been made, and an area in Kattegat has been pointed out. A frame of 800 tonnes of Nitrogen discharge has been granted, which is estimated to correlate to a production of 8 000 tonnes. It is highly doubtful that this target will be reached before 2020. Legislation has to be decided and environmental organizations can still obstruct the plans. An amount around 380 tonnes of Nitrogen discharge has been granted to land based recirculated facilities, which in turn is estimated to correlate to a production of between 10 000 and 15 000 tonnes. Danish Aquaculture organization believes this is an obtainable goal before end of 2020. The administrative procedures are still perceived by the farmers to be the main hindrance for raising production volume, as it has been very time consuming to go from the existing feed quota system to the new output based regulation focusing on nitrogen emissions.

In conclusion, the Increase in marine production seems difficult to achieve before the end of 2020 due to lack of time, but might be achievable before end of 2030. However, an increase in freshwater production seems obtainable according to the Danish Aquaculture organization. If no legislative or administrative interference occur, an increase of 10 000 to 15 000 tonnes would fulfill the Danish goals within the planed timeframe.

In the following, the development in DCF volume and value is shown compared to the Danish National program.





Note: Reported turnover converted to 2013 euros

5.4.4 Estonia

1: Overall goals for the national program

Estonia's vision for aquaculture in 2020 is to build up a leading position in their own domestic market and to become a successful exporter of species that suit local farming conditions and have a high demand in foreign markets.

Fourteen objectives in total have been formulated in the multiannual national plan for the aquaculture sector of Estonia (three for the first Strategic Priority (SP1) of the Guidelines - simplification of administrative processes, one for SP 2 - facilitating access to space and water, six for SP 3 - strengthening the Competitiveness and four for SP 4 - promote a level playing field for EU operators).

2: Planned measures and actions:

To achieve the goals Estonia is planning to use EMFF funding. In frame of the EMFF the aquaculture sector is supported by the following measures and activities:

- Aid for innovation in aquaculture;
- Aid for cooperation between researchers and aquaculture companies;
- Support for finding new markets for fishery and aquaculture products and for promotion campaigns for fishery and aquaculture products;
- Support for collective investments in the processing of fishery and aquaculture products;
- Support for energy and resource efficiency in the processing of fishery and aquaculture products;
- Investment loan for aquaculture companies.

3: Implementation and achievement

The implementation of the EMFF measures is at an early stage and making conclusions on the impact is still premature.

According to the development strategy for the Estonian aquaculture sector the probable volume of the Estonian market for aquaculture products is estimated at 6500 tons in 2020. Thus, to achieve the vision for aquaculture in 2020, Estonian aquaculture production must reach more than 3000 tons of sales. This number is consistent with the investments are made in aquaculture sector.

In 2014, the sales volume of commercial fish amounted to around 869 tonnes and it has remained rather stable until 2017. In 2016, the National Audit Office completed an analysis of the impact of aquaculture grants received from the EFF, which focused on the use and effectiveness of grants paid during the period 2004–2015. According to this analysis the existing fish production capacity of Estonia was estimated at more than 4 000 tonnes per year, but actual production accounted for around one-fifth of that figure. It was found that the main reason for production volume being significantly lower than the potential capacity was the fact that new farms did not operate at full capacity and that the loss of fish on farms was high. However, it must be taken into account that the effect of any investment is usually seen after several years it is made.

5.4.5 Finland

1: Overall goals for the national program

Finnish national plan objective is to increase the production volume by 46% from 13 700 tonnes to 20 000 tonnes in 2020. This is to be achieved by 4 guiding pillars; Simplify administrative procedures, coordinated spatial planning, Enhancing competitiveness and levelling the playing field.

2: Planned measures and actions:

Simplify administrative procedures: Review the permit processes in cooperation with the administration and stakeholders. The objective is to lighten the administrative burden caused by the environmental permit system and related procedures. The permit system will be developed to be straightforward yet not compromise the level of environmental protection provided.

Enhance competitiveness: A multiannual innovation and development programme is being promoted to support the growth of sustainable aquaculture, which will be put into practice following the principles of learning and network-based development. And construction of a network of technical expertise and innovation in aquaculture, within which the sector can develop to a high international standard, facilitated by multi-stakeholder cooperation. Aim to develop strong PPP –models and platforms to research and industry.

Coordinated spatial planning: Finland has adopted an aquaculture spatial plan that identifies the most suitable and productive areas for aquaculture production in marine areas. This plan will be integrated into the national marine spatial plan, and will be supported by the permitting system.

Environmental monitoring obligations: For the water quality monitoring, the aim is to find the most appropriate methods for investigating and assessing the environmental impacts of fish farming.

Level playing field: The plan recognises a need for better communication to the public about the sector's responsibilities to ensure environmental sustainability and its important contribution to achieving nutrient reduction targets set for the Baltic Sea.

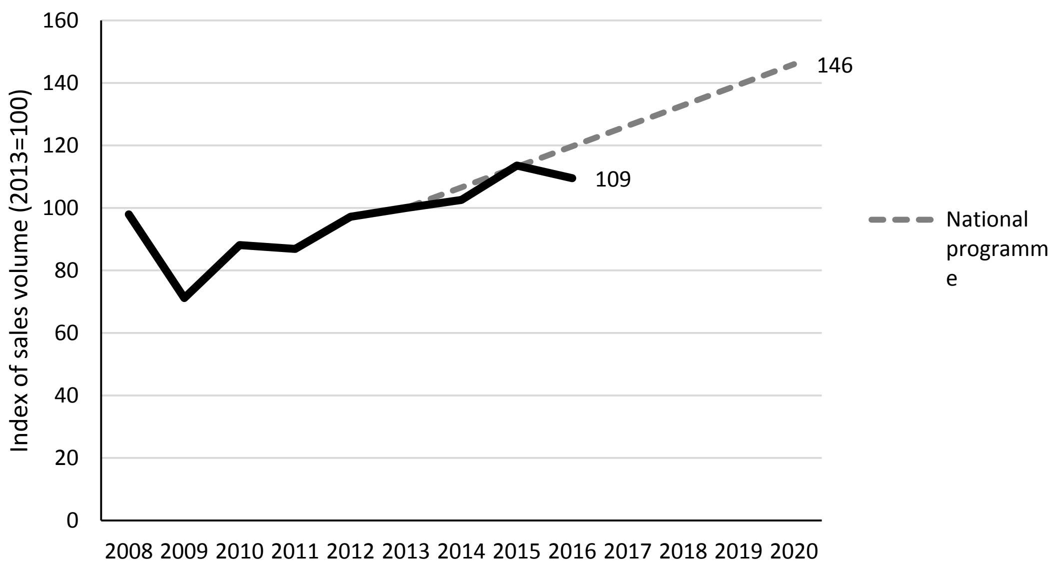
Best practices will be promoted by continuous dialog; between industry, environmental NGO's, research and administration in order to reconcile environmental and industrial policies

3: Implementation and achievement

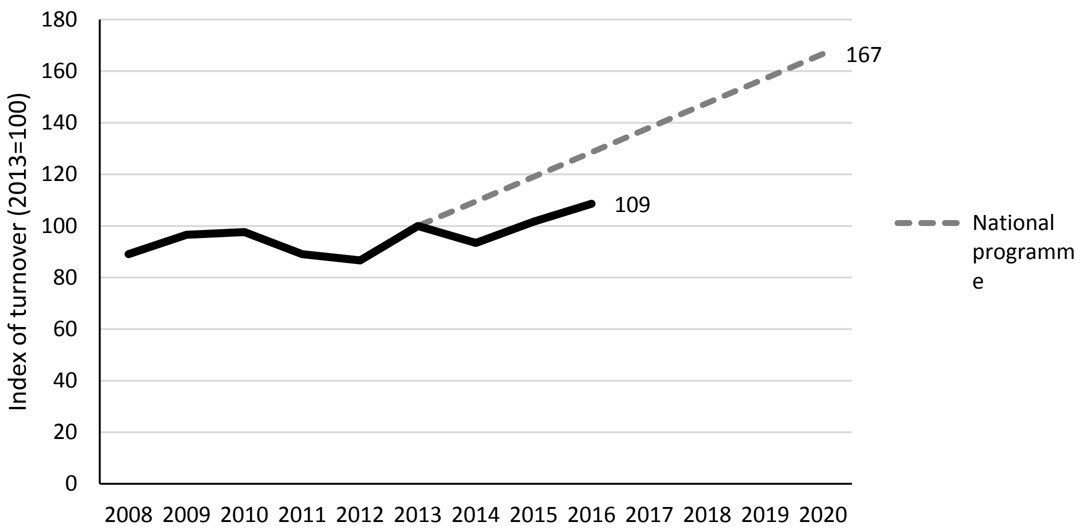
The development Finnish aquaculture sector under EMFF is mainly based on innovation programs. These multiannual innovation programs are aimed at sustainable development that will benefit the entire sector. The aim of the programs is to foster network development through business partnerships between private and public actors and to focus on achieving the key goals of the Finnish action program.

According to Finnish Annual implementation report the number of financed projects are still relatively small. However, strategically most important projects for the whole industry, especially innovation programs, have been pursued as early as possible during the program period. By 2017 aquaculture innovation project had started.

ASSESSMENT OF THE DEVELOPMENT



The graph shows the development of aquaculture production with the production target set in National plan. The production has increased steadily until 2016 when it stagnated. The production value development is strongly dependent on prices. After slight decrease in 2014 the production value has been increasing due to the sharp increase in prices and was further improved with prices in 2017.



Note: Reported turnover converted to 2013 euros

The objective of the national plan is ambitious. Even the outcome is not following the long term linear growth path there is clear increasing trend in both production volume and value. However, the measures under EMFF are mostly based on development projects that are carried on during the whole programming period – e.g. the innovation projects – that the outcome is expected to be fully materialised in longer term. Also it should be noted that the development presented here is mostly affected by exogenous factors as global salmon markets and the impact of EMFF requires deeper analysis.

5.4.6 France

1: Overall goals for the national program

The objectives of the French national strategic plan for aquaculture aims at boosting competitiveness and sustainability of the French aquaculture sector. The action fields expected are on technological development, innovation and knowledge transfer, competitiveness and viability of aquaculture enterprises, and protection and restoration of biodiversity.

By 2023, aquaculture activities are expected: (1) To reinforce the place of aquaculture in French territories and develop the employment: shellfish farmers and fish farmers are actors involved in water quality and aquatic ecosystems. Their role of environmental observation should facilitate the integration of aquaculture activities in the territories; (2) Develop sustainable aquaculture production activities by supporting farmers in the improvement of environmental performance and the implementation of risk management tools; (3) Increase the value of products throughout the value chain: the French market for aquatic products (fisheries and fish farms), highly dependent on imports, has substantial growth opportunities for the different aquaculture sectors, subject to offer consumers guaranteed products to their origins, production conditions and their health and organoleptic qualities; (4) Increase and share expertise, knowledge and innovation for development of aquaculture activities. The development of this sector is largely based on research, development and innovation. These different points should be shared with society and consumers. Many aquaculture issues require improved knowledge: shellfish mortality, feed efficiency in fish farming, effluent limitations, closed circuits, new adapted species or descent, supply management spat, etc.

For 2014 to 2023, the French expected growth objectives are: (1) an increase of 47 000 tonnes by 2023 with maintaining of shellfish production and increasing fish farming and seaweed production; (2) an increase of €343 million of value by 2023. Concerning the effect on FTE, funding will aim at developing attractiveness of jobs in the aquaculture industry, encouraging evolution from part-time employment to full-time employment through diversification of activities, supporting installation of young entrepreneurs and improved access to training. The objectives are to maintain 10 000 FTE and create 500 new FTE.

2: Planned measures and actions:

Five types of actions with sub-targets has been defined:

(1) Improve the governance of the interfaces between administrations and professionals through:

(1.1) a progress plan: the objectives of this plan are to support the efforts of fish farmers to strengthen and develop their farms, through a good integration of environmental and sanitary requirements. The main issues of this plan concern the balanced management of water resources including aspects of ecological continuity, discharges and respects of stream flows.

(1.2) setting up a working group to simplify the environmental regulatory framework for fish farms.

(1.3) a lawful securing of aquaculture development projects.

(1.4) a better spatial planning.

(2) Strengthen the role of aquaculture in the territories and develop employment. Measures are intended to support the modernization of existing aquaculture farms and investment in new enterprises.

(3) Develop the sustainability of aquaculture production activities through:

(3.1) a national eradication and surveillance programme

(3.2) and studies on the opportunities of supporting insurance systems in aquaculture and on risk management.

(4) Increase the value of products.

(5) Better develop and share skills, knowledge and innovation for aquaculture development.

3: Implementation and achievement

(1.1) A progress plan for freshwater fish farming has been set off between ministries and professionals. The first step of the progress plan (current state of fish farms, reporting tools, carrying out diagnostics) are achieved but the concrete implementation of the plan runs into difficulties: technical obstacles in relation with complex definitions (e.g. good ecological status of water); the engagement and coordination at the same time of different State departments; the cost of the obligatory reports of consultancy firms faced by fish farmers to demonstrate the containing environmental impacts; funding for non-productive investments. These actions are funded by the measure 50.1.c of EMFF.

(1.2) Consultation meeting between State departments and professionals was held in December 2017 and must continue in 2018 to achieve a simplification of the rules for fish farms.

(1.3) an inventory of contentious and unsuccessful projects has been initiated in 2017. An analysis of the main causes for litigation and the abandonment of projects, which hinder the development of marine aquaculture, will be carried out in 2018.

(1.4) A feasibility study of the tools is henceforth available at the national level to identify the best aquaculture sites in the world in 2017. For the future, there are plans to set up a data center (mapping web portal) and to support the development of different types of marine cultures on the environment. These actions are funded by the measure 51.1.a of EMFF.

(2) 46 new enterprises have been supported through EMFF (measures 48, 60, 62, 63) with new activites (aquaponics) or new techniques (recirculation systems, ...)

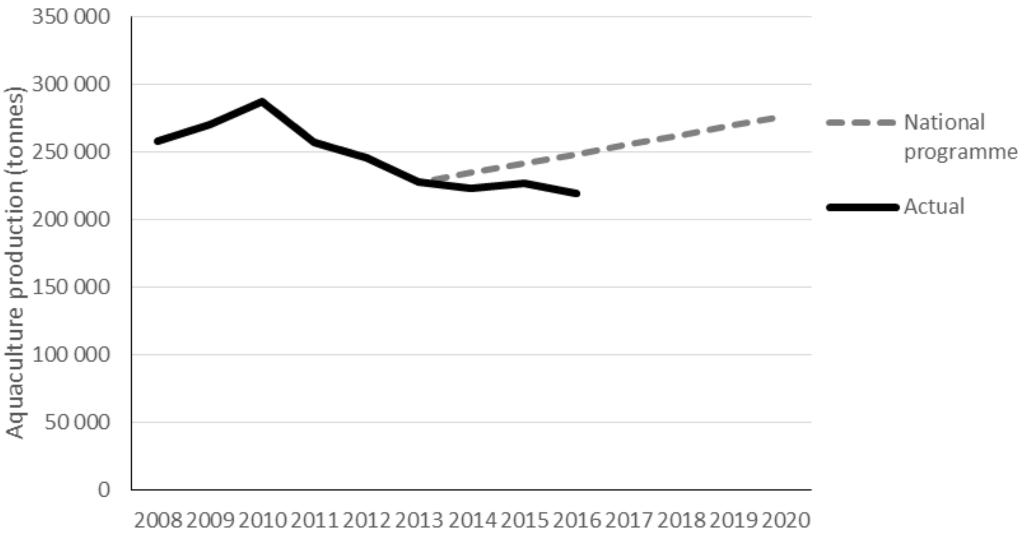
(3.1) Operational implementation of the national eradication and surveillance programme has lagged but must fully commit to starting from 2018 via measures 56.1.a, 50.1.c and 56.1.e (constitution and functioning of sanitary defense groups).

(3.2) A risk assessment mission took write a report in 2017 and propose a system is based on three complementary levels (individual savings, creation of mutual funds (Measure 57) and the use of measures 56.1.f and 55 for exceptional phenomena). Meetings between State departments and professional will be held during 2018-2020 in order to implement individual savings and mutual funds

(4) A national coordinator for the shellfish sanitary strategy was appointed in April 2016 to curtail excess mortality in shellfish and promote product safety. No results are available in 2018.

(5) In 2016 and 2017, two calls for proposals have been organised for projects focusing on innovation in aquaculture resulting in the selection of 33 projects in total (involving mostly collaborations between research centres / technical institutes and professional organisations of aquaculture sectors). Results of these projects are not yet available.

These different programs or projects have the potential to produce benefits and generate continued progress towards growth or employment. It is too early to evaluate their effectiveness. Furthermore, a lot of external factors could influence the level of production such shellfish mortality, price volatility, environmental hazards. So, national growth objectives are the maximum values possible.



5.4.7 Germany

1: Overall goals for the national program

There are three primary objectives of the German multi-annual national plan (*Nationaler Strategieplan Aquakultur für Deutschland*, NASTAQ):

i) Stabilizing the present capacities of the sector;
ii) Growth; increase of total production from around 26 500 tonnes (2012) to 52 000 tonnes in 2020; thereof the freshwater sector should extend by 148%, marine finfish farming should increase from <50 tonnes to 1 000 tonnes in 2020; and marine shellfish production is aimed to increase by 144% until 2020.
iii) Maintenance of the (extensive) traditional pond aquacultures, which are not only economic enterprises, but also provide ecological and cultural (landscape heritage) services for the society.

Recirculating aquaculture systems (RAS; various species) and modern raceway systems (salmonids) play a crucial role for the achievement of the growth objective. It is aimed that up to 100 RAS with a production of 20 000 tonnes should be established until 2020. At the same time the production from raceways should increase up to 20 000 tonnes. Moreover, new mussel aquacultures with a capacity of up to 10 000 tonnes are intended to build up in the Baltic Sea.

2: Planned measures and actions

To strengthen the competitiveness of the sector, aquaculture research institutions, which are distributed in the federal system of Germany, should intensively network and cooperate under a coordinated national aquaculture research strategy. First and foremost, this research strategy should include the development of vaccines and the improvement of production technology. Breeding programs should lead to enhance productivity and fish health. In order to simplify administrative procedures an assessment of the relevant legal framework and followed by a probable reform is pointed out. Further, the construction law intends to be reviewed and revised towards a privileged status for aquaculture projects. Pilots should help applicants in the authorization progress. The development of guidelines for the licensing and training of licensing authorities should enhance the knowledge about aquaculture practices. A coordinated spatial planning is proposing to build up mussel and integrated multi-trophic aquaculture facilities in the Baltic sea. Coordinated campaign should enhance the acceptance of aquaculture in the public; marketing of regional products should be improved via a cooperation between state and the industry.

3: Implementation and achievement

The production of freshwater species, in particular of trout and carp, oscillates around 20 000 tonnes per year. Marine mussel aquaculture had an exorbitant harvest in 2016 with a production of 22 000 tonnes, which can be explained by natural rather than by human impact. In consequence, the first objective of stabilizing the production seems to be achieved. The aquaculture license authorization process has been enhanced or is on its way to improve; but only in some federal states. E. g. Schleswig-Holstein has created the position of an authorization process pilot, an aquaculture network with national importance (KNAQ), and guidelines for aquaculture investors. Mecklenburg-Vorpommern has established a spatial planning and designated priority areas for aquaculture. Lower-Saxony have introduced payments to compensate fish loss through protected wild life in aquacultures. Bavaria have compensation payments for eco-system services provided by extensive aquacultures. On the contrary, the establishment of a virtual center as the core of a coordinated research activity across the nation failed; also it is not possible to privilege aquaculture facilities in the building law. Moreover, the preparation of national guidelines according to the European Maritime and Fisheries Fund (EMFF) took alone 2 years. In Germany, 16 single federal states are responsible for aquaculture issues. The majority of the respective and usual small administration units for aquaculture finalized the guidelines only 2016. A lot of the abovementioned measures depend on EMFF payments. Thus, the start of measures has delayed in many cases.

Definitely, the objective of growth is not sufficient achieved nor on its way to be fulfilled until 2020. The production volume of the single segments has been far behind the growth objectives formulated in the NASTAQ. In particular, the RAS production potentials seems to be overestimated. In 2017, there were 50 companies, which is a quite well development, but they only produced around 2 700 tonnes together. The same applies to salmonid systems, whose production has not changed at all and has stabilized around 10 000 tonnes. Even more there seems to be a serious lack of successors for traditional aquacultures. From 2015 to 2017, the number of farms decreased from 3 285 to 2 706 (Destatis). Noting that overall production changed not as much, the data indicates that first and foremost smallest traditional (extensive) farms close down. Against that background, the objective of maintenance cannot be seen as achieved and will probably not achieved until 2020. To fasten up the implementation of the well-chosen measures and to strengthen the coordination of them on national level could significantly facilitate the achievement of the NASTAQ's objectives, but probably not until 2020. Therefore, at least the objective of growth is too ambitious.

5.4.8 Greece

1: Overall goals for the national program

The overall quantified strategic objective of the Greek national strategic plan is 7% mean annual increase of aquaculture production till 2030. This, rather ambitious, production goal translates to approximately 170 thousand tonnes to be produced in 2020 and 330 thousand tonnes to be produced in 2030. We estimate that the annual production in 2023 will need to exceed 200 thousand.

2: Planned measures and actions:

The main priorities of the Greek national strategic plan are: 1) Simplification of the licensing system for the aquaculture, 2) Ensuring sustainable aquaculture development through coordinated spatial planning, 3) Strengthening of competitiveness, 4) Promotion of a level playing field in terms of competition.

Among others, simplification measures refer to the establishment, adoption and implementation of rules for the new aquaculture law, operation of the competent license authority as a one-stop shop, establishment of a National Council for aquaculture and encoding environmental requirements for the establishment of new aquaculture sites.

Sustainable aquaculture development measures refer to the Implementation of a spatial development model, establishment of new production sites, organization of existing production sites, regulation of the relations between coastal zone stakeholders, diversification of future production, development of offshore aquaculture and encouraging of organic aquaculture production.

Measures focusing on strengthening of competitiveness refer to production increment through improved yields at existing sites and creation of new sites, R&D strengthening towards increasing productivity and diversification, reduction of production costs through clusters and synergies along the value chain.

Regarding leveling of the playing field, measures refer to the establishment of producer organizations, promotion campaigns for aquaculture products, improvement of processing and packing and improvement of quality and certification of aquaculture products.

3: Implementation and achievement

The vast majority of measures and actions described in the Greek national strategic plan for the aquaculture have been implemented except of the establishment of integrated production clusters which has been delayed for 2019. The establishment of these clusters is expected to reduce the administrative burden and the operating costs by supporting coordination and cooperation between neighboring aquaculture farms.

Nevertheless, we may not identify any macroeconomic trend suggesting a large increase in the demand for the Greek aquaculture products given the current sales price, the production costs and the competition from non EU countries. Given also the facts that:

- The Greek economy is still under recovery from the recent debt crisis,
- The target of the EMFF Operational programme refers to 30 thousand tonnes increase in production volume by 2023 while until late October 2018, no projects have been approved for funding in Greece,
- It is mostly the marine fish aquaculture which is expected to contribute to the increase of production,
- The consolidation of the marine fish aquaculture is still ongoing and the major production companies are expected to be owned by the same capital management fund in 2019, a fund that also owns aquaculture companies in Spain,

While the production figures till 2016 seem to be on track with the plan, we expect that it is rather unlikely for the production target of the strategic plan to be met by 2023 unless new production sites are licensed during the next two years (2019-2020).

5.4.9 Ireland

1: Overall goals for the national program

Production goals are to reach 81 700 tonnes of output, worth €307 million by 2023 of high end product, in an environmentally sustainable manner. This is to be achieved by 4 guiding pillars; Simplify administrative procedures, coordinated spatial planning, Enhancing competitiveness and levelling the playing field.

2: Planned measures and actions:

Goal 1: Review and revision of the aquaculture licensing process, including the applicable legal framework. Developing a data management and information system with online aquaculture license application.

Goal 2: Aquaculture incorporated into an effective and equitable marine spatial planning system. Spatial mapping of aquaculture sites. Identify and provide guidance in developing tourism-related opportunities for producers. Study on integrated multi-trophic aquaculture and possible synergies with offshore marine renew able energy units.

Goal 3: Provision of expert advice to improve business performance. Build capacity and scale in the industry through a commercial Aquaculture Development Scheme with investment support to SMEs. Enhance the skills base to foster a knowledge economy through networking, training, mentoring etc. Applied research and collaborations between industry, scientific and development bodies.

Goal 4: Aid shellfish producers affected by major biotoxin episodes. Promote organic aquaculture and best practice codes safeguarding against disease, parasites, invasive species etc.

3: Implementation and achievement

The goals aimed at producing high end, sustainably produced products is being achieved. The licencing process has been reviewed and an on-line transparent system is in design process. A data centre and insight service project is at the planning stage. A new training scheme aimed at developing management and leadership skills is underway and the development of the marine spatial planning system and projects to integrate aquaculture practices with each other and with other stakeholders in tourism and wind energy are underway as intended. A commercial development scheme is in place.

The projected volume of 81 000 tonnes is however unlikely to be achieved, notwithstanding a speedier licence application process and spatial planning system being developed, unless salmon production can rapidly relocate offshore. There are many competing stakeholders for the limited area available inshore, only some of which is production viable and less of this will become licenced as expansion will be frustrated by an effective anti-fish farm lobby.

5.4.10 Italy

1: Overall goals for the national program

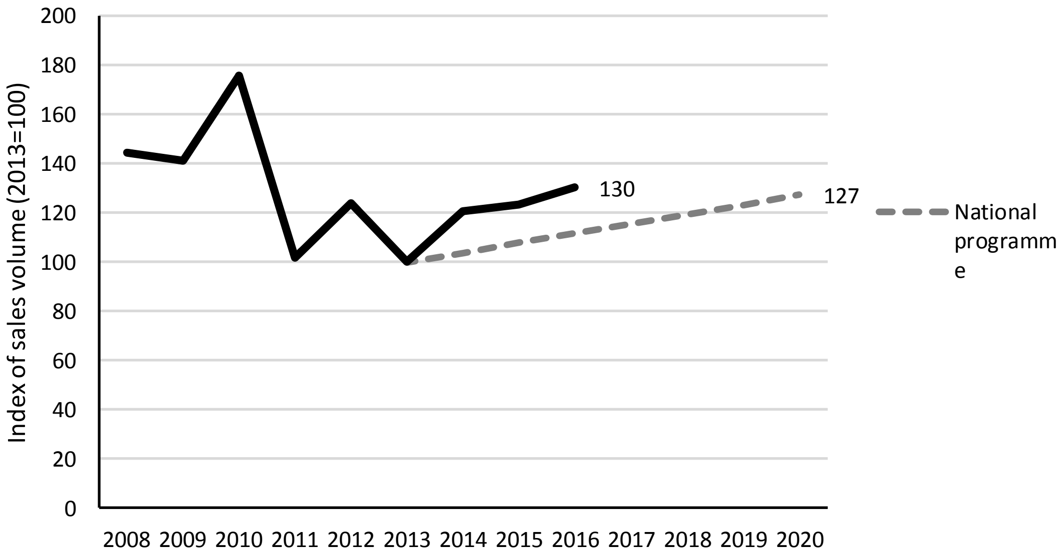
The Italian Strategic Plan for Aquaculture (PSA) refers to the period 2014-2020 and includes forecast analysis of the growth of aquaculture up to 2025. PSA has set as its first objective the development of aquaculture activities in Italian freshwater and marine areas to create economy, employment and social benefits. The strategy has been structured to pursue the goals of "smart, sustainable and inclusive" innovation and growth. It was based on 4 macro strategic objectives. Overall production is planned to rise from 140 879 tonnes in 2013 to 206 854 tonnes in 2025 (32% increase). Production value from 393 000 to 641 000 by 2025 (38% increase).

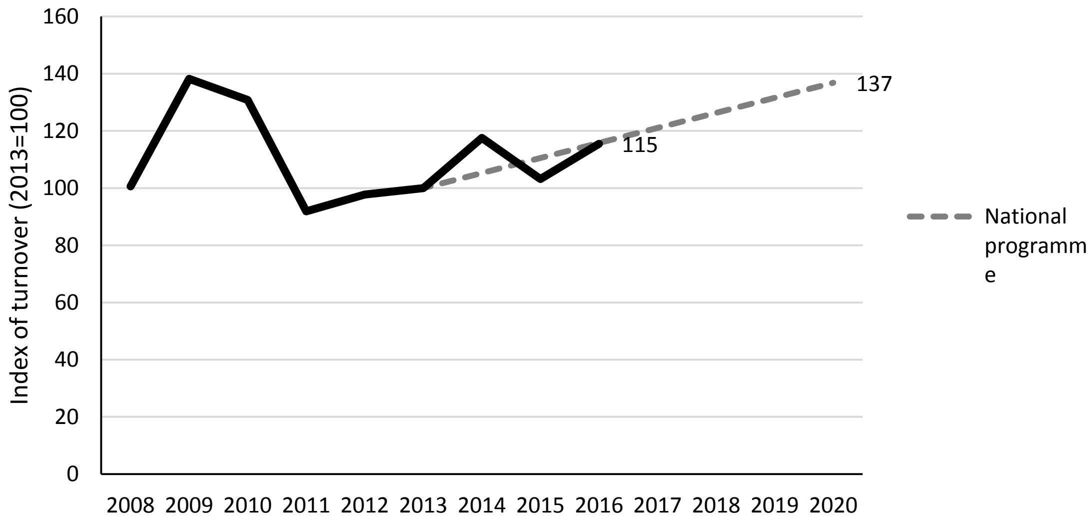
2: Planned measures and actions:

Administrative and bureaucratic simplification: single framework law, coordination of State/Regions and territorial offices; stakeholders: permanent consultation (Aqua-Platform). *Guarantees the growth of the sector through measures to define the* AZA: to improve the use of marine areas; assign protected areas to mussel farms; aquaculture planning in areas of high environmental importance (Natura2000), and mapping farms located in Natura2000; improve the

Environmental Impact Assessment (EIA); support companies to obtain environmental certifications (EMAS and organic); ensure the availability/abundance of water, energy efficiency of continental aquaculture. *Promote competitiveness*: improve the productive performance of SMEs; strengthen technological development; strengthen professional figures (long-life training); promote animal welfare. T*o endure the fair competition of farms, Producer Organizations (POs)*: market observatory; labeling/certification; instigate new markets; POs and trade associations; communication/advertising; interactions between farms and FLAGS and aquafarmers in Mediterranean Region.

3: Implementation and achievement





Note: Reported turnover converted to 2013 euros

The administrative and bureaucratic simplification, with attention to the regulation of state concessions. Simplification will be the subject of the framework law for fishery. Draft legislation n. 2914 "Interventions for the fishing industry" approved by the Chamber of Deputies and the Italian Senate. PSA has provided for a central coordination unit between the State/Regions, the so-called Cabina di Regia. In support of the Cab, AquaPlatform was set up, ITAQUA. The objective of allowing companies to grow has been achieved through the drafting of guidelines for the definition of AZA and the guidelines for the EIA. By 2018 the state/ Regions comparison is planned to share spatial planning methodologies and tools for AZAs. For mussel farming, important milestones have been achieved in creating protected areas for mussels. Competitiveness calls have been launched between 2016-2017, mainly to support technology modernization. Competition in the market has been supported with EMFF measures have been used to support the processing (M.5.69) and commercialisation (M.5.68) of aquaculture production. New credit, insurance and financial instruments were activated in 2018. In 2019, certification actions have been scheduled, which have not increased since 2015.

Starting from 2013, an exercise has been undertaken to compare the forecast analysis to 2025 reported in PSA-Italy (based on Eurostat data 2013) with real performance in volume and value reported in DCF. The growth forecasts from PSA-Italy to 2025 evaluated at the 2016 confirm the growth of the Italian aquaculture sector +30% for volume and +15% by value. This is on course to meet the forecasted production target for volume but is slightly off track by value. The data used for 2016 has been estimated according to the rate of change from 2015 to 2016 in the FAO data, because the volume of sales referred to 2016 have been based on less segments, according EUMAP. New segmentation considered 5 national main segments rather than 9, as in DCF, until 2015. Detailed information has been transmitted by Ministry according to Guidance document for the Mid Term review of Multiannual National Plans for the sustainable development of aquaculture.

5.4.11 Latvia

1: Overall goals for the national program

The Multiannual National Plan for the development of sustainable aquaculture provide the basic National Growth Objectives 2014- 2022 according to the reported aims in the Latvian Operational program for fisheries development 2014-2020:

- Increase in production volume by 250% or 2256 tonnes in 2023 in comparison to 2013 (644 tonnes).
- Increase in labour productivity by 20% in terms of € / person by 2020.

2: Planned measures and actions:

The main tasks planned for the simplification of the administrative procedure are:

- improvement of data collection to allow better evaluation of economic growth and return on investments;
- revision and improvement of aquaculture performance indicators.

The main tasks planned for the enhance of completeness are:

- support for developing environmentally-friendly production technologies and increasing product promotion;
- support of technical development and innovation;
- development of the competence centre which implies the activities aimed at improvement of life-long learning and a stronger cooperation among researchers, as well as improvement of the knowledge transfer for the aquaculture enterprises.

The Multiannual National Plan identifies a number of examples of best practice, including trainings: e.g. through the exchange of experiences and information and the establishment of an accredited trainings program for aquaculture provided by National Fisheries Network; innovation and knowledge transfer: e.g. through the activities of the Complex Industrial Mechanical and Biological Research Centre which has been working on the development of recirculating aquaculture systems (RAS), a new generation of fish incubators, wild animal selection and domestication and genetic engineering.

3: Implementation and achievement

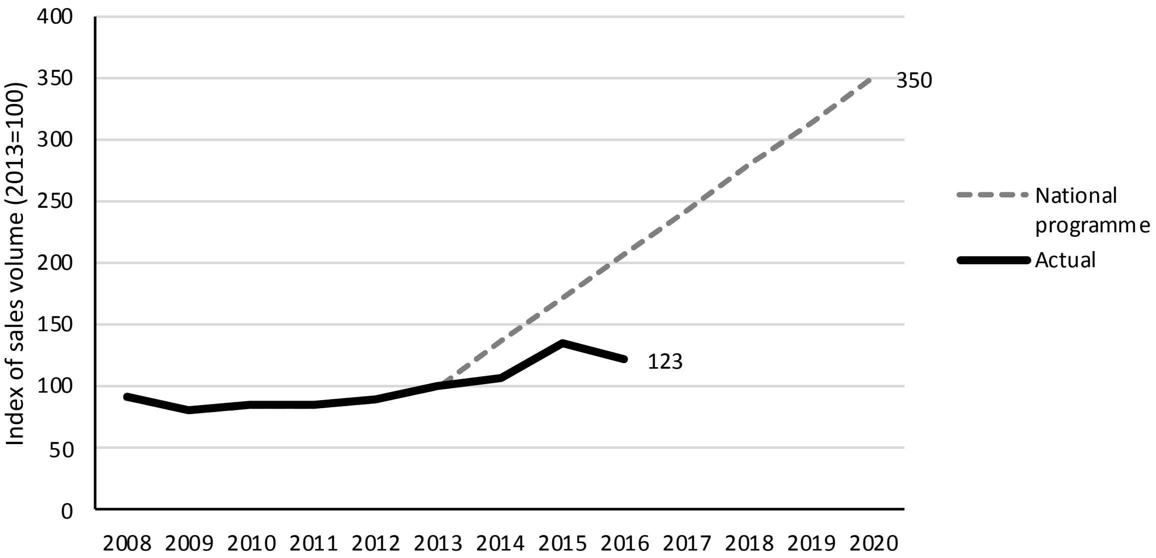
The tendency shows Latvian aquaculture sector positive development. Some of the planned measures or actions already were implemented.

The Central Statistical Bureau of Latvia (CSB) carries out data collection on aquaculture sector. The variables such as production by species in tones and value, total area of fish ponds, volume of rearing tanks and number of employments are included in the questionnaire form "1-Aquaculture". The questionnaire form was revised in 2014 and detailed information about income and costs, as well as investments and annual depreciation were included in the form according to the variable list provided in the *table 7* COM 2016/1251. The first data for the new variables were received for 2015 and 2016. The BIOR institute carried out data collection on social data. The data collection for the social variables listed in table 6 Social variables for fishery and aquaculture sectors was implemented in 2018 for the first time. The variables were collected for 2017.

The data submitted to the EUROSTAT show the increase in production of volume and value by 17% and 20% respectively or more by 136 tonnes in 2016 in comparison to 2013 (644 tons).

The project submission round for the event "Investments in aquaculture enterprises" was organized in 2015. The aim of the measure was to modernize and improve aquaculture enterprises, develop traditional aquaculture methods, develop new and highly demanded species of aquatic animals, and to implement aquaculture methods that significantly reduce the negative impact on the environment.

Using up the recirculation systems becomes more popular in Latvian aquaculture. The number of recirculation systems increased by 25 in 2016 compared to 2010 and in its turn increasing the capacity (in m3) for fish farming in that segment by 8 times.



The Aquaculture Research and Education Centre of Fish farm "Tome" of the Scientific Institute "BIOR" was developed and operated since 2016. The research centre organizes seminaries, conducts theoretical and practical training of specialists as well as provides consultations for fish breeders in Latvia. The aim and objective of the center is to make aquaculture studies and to organize practical and theoretical training for new and experienced specialists. The research is made in research fish breeding lines of the centre and in hatcheries of the institute. The centre ensures a suitable place and circumstances for the training and work of the researchers. It also provides consultations in fish breeding and ihtiopathology and summarizes the results of the research conducted as well as informs the society (seminaries, publications, reports in the website of the Institute, etc.). The studies conducted are linked with the improvement of the quality of fish fries by using various substances enhancing immunity as well as by perfecting fish breeding and cultivation processes. Close link between the research centre and state hatcheries open a possibility to involve high level experienced specialists in the research work. Two experimental fish breeding lines that have been established perform various practical research activities that are necessary for the sector in the areas of aquaculture and ihtiopathology. This is the first step as well as serves as the scientific basis and support for the planned fish breeding bank at Fish Farm "Tome". It is planned to construct Stage 2 newly established fish breeding, research and education center of the scientific institute "BIOR" by year 2020 as well as by receiving financial support from the European Fisheries Fund.[27]

[27] https://www.bior.lv/en/about-bior/aquaculture-research-and-education-centre-fish-farm-tome/aquaculture-research-and-education-centre

5.4.12 Lithuania

1: Overall goals for the national program

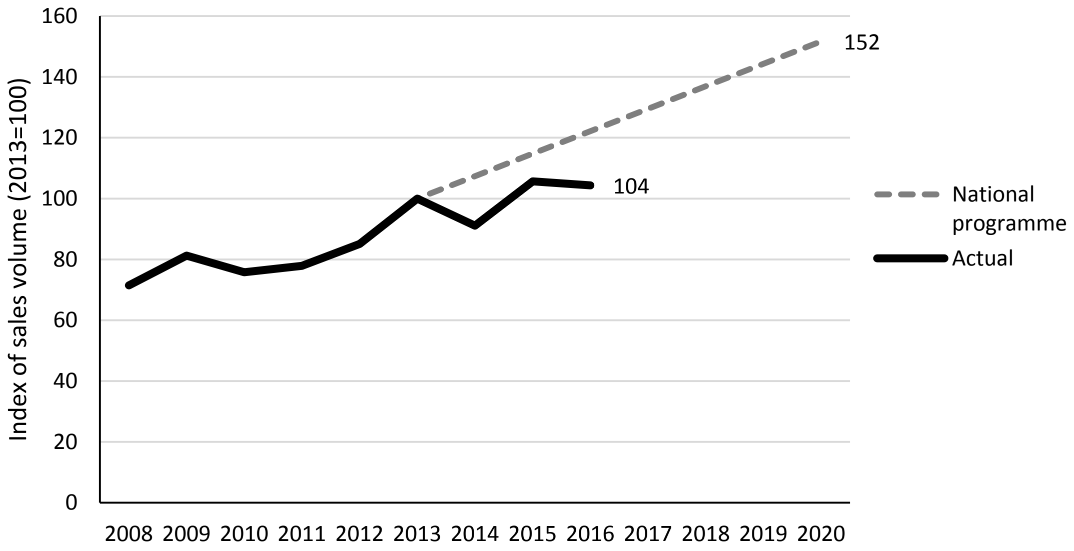
The goal of the 2014-2020 Multiannual national plan for the development of sustainable aquaculture in Lithuania (further – Multiannual plan) is to provide public support for an economically sound and dynamic development of the aquaculture sector, which will provide the basis for sustainable and competitive aquaculture production of traditional and new species, meet Lithuanian and export needs for live, fresh and processed fish products. The Multiannual plan is divided to three directions for implementation. The goals for the first direction is to effectively use and strengthen the existing aquaculture production potential, to diversify production and expand the range of products using "environmentally friendly" technologies; second direction of the Multiannual plan focus on the measures to increase competitiveness of the aquaculture sector by developing the most productive technologies in the market and promoting exports; third direction aiming to create the necessary services for the aquaculture sector, to develop and share knowledge and practices. The goals for the Multiannual plan do not include the simplification of administrative procedures as analysis of administrative burden on Lithuanian aquaculture revealed that administrative procedures are not a factor that is limiting sector development and competitiveness. Concerning spatial planning the current capacity of pond aquaculture is underexploited, a significant part of pond area is not used and thus the further development of spatial planning for aquaculture is not a priority

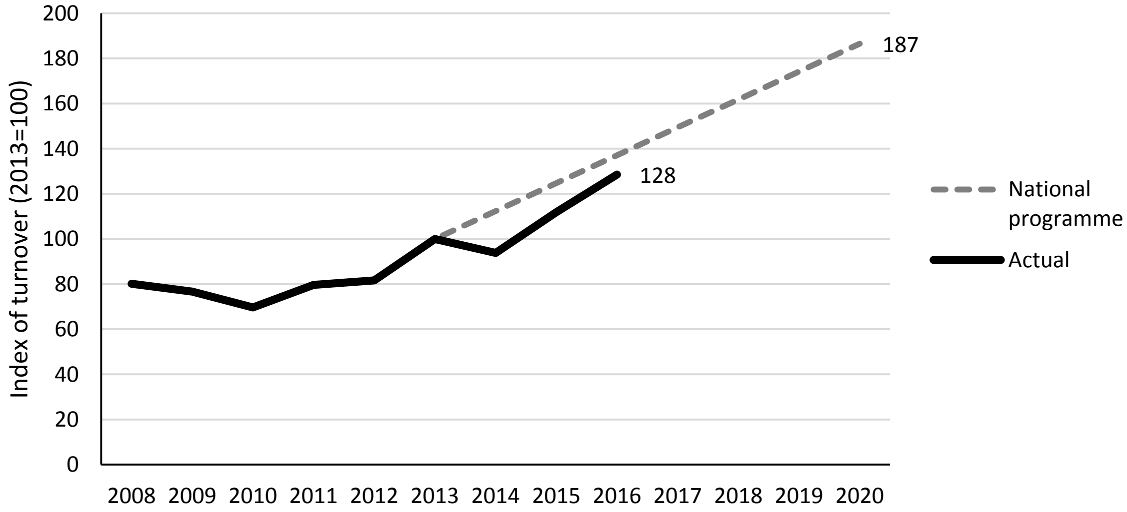
2: Planned measures and actions:

To achieve the national growth objectives for production volume and value planed measures will focus on modernization of the technical base of existing aquaculture enterprises to increase the productivity of ponds by expanding the demand for fish production in polyculture conditions; to promote the development of the fish hatcheries and nurseries; to promote the processing of aquaculture products made by aquaculture enterprises, to develop and use new fish processing technologies for the production of competitive products; to encourage producer organizations to present the most advanced products and achievements of aquaculture enterprises at international and local exhibitions, fairs and other public events; based of the best practice from EU MS, to promote the establishment of large scale RAS systems (1000-1500 t). Other objectives of the Multiannual plan which aims to create the necessary services for the aquaculture sector, to develop and share knowledge and practices is planned to be reached by the establishing of an industrial laboratory for aquaculture, focusing on hydrochemistry and ichthyopathology; establishing a breeding center for fish like sturgeons and trout; cooperation with scientific bodies implementing aquaculture training programs and aquaculture associations in order to increase their efficiency and to improve the dissemination of scientific, technical and market information to aquaculture enterprises.

3: Implementation and achievement

For the implementation of the Multiannual plan, the targets of the aquaculture production were set to 4.6 thousand tonnes to be reached in the 2017 and 6.4 thousand in 2022. Total value of aquaculture production in 2017 is foreseen to increase to €11.29 million with further growth to €18.8 million in 2022. According to the aquaculture production data of 2017, total aquaculture production was 3.7 thousand tonnes. The target was not reached due to the extremely unfavorable climate conditions which affected outdoor aquaculture and closure of the large scale trout producers in RAS which went out from business. In 2017 production volume declined by 14.7% compare to 2016 when the volume of production reached 4.4 thousand tonnes and was sufficient progress in line with program targets. However, the value of aquaculture production increased significantly and exceeded the target of the Multiannual program by 7.3%. Further growth of the value of aquaculture productions is on the right track and likely will reach the long term targets. One of the main drivers of increase in production value is the successfully implemented measures concerning diversification of production and promotion of the processing of aquaculture products as well as implementation of efficient marketing measures.





Note: Reported turnover converted to 2013 euros

5.4.13 Malta

1: Overall goals for the national program

Production goals, environmental goals, goal for spatial planning, minimize administrative burdens, enhancing administrative burdens etc.

The National Aquaculture Strategy lays out a framework, for the period 2014-2025, which focuses on multiple key aspects:

- Promoting aquaculture as a key maritime sector;
- Steering growth towards sustainability;
- Clarity in regulation;
- Simplifying administrative procedures;
- Co-ordinating spatial planning and;
- New Potential for growth – search areas;
- Sustainability through improved environmental management;
- Enhance competitiveness through innovation.

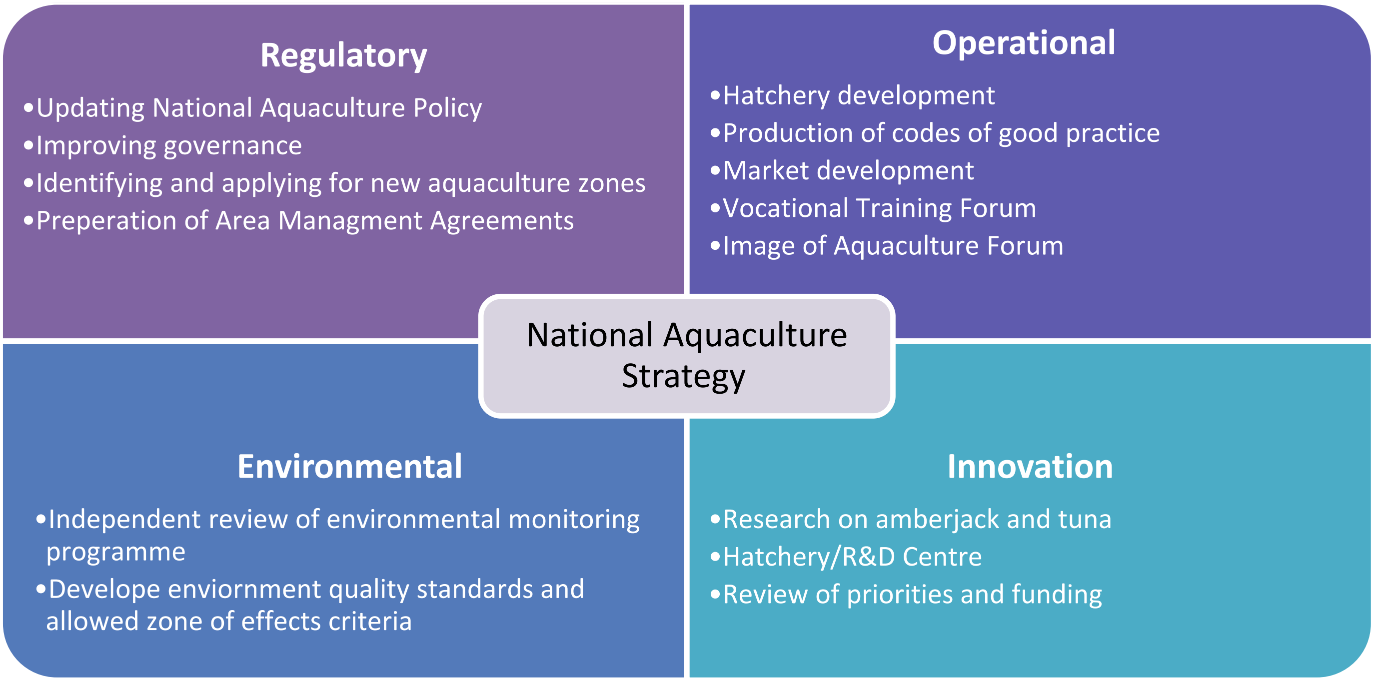
National Targets Emanating from the National Aquaculture Strategy:

- A yearly production target of 5 000 tons for closed cycle species;

- A 60% increase in production volume of closed cycle species;
- A 22% increase in the production volume, from 8 606 tonnes to 10 500 tonnes by 2020;
- A 19% increase in the production value from €101 million to €120 million by 2020.

2: Planned measures and actions:

The strategy looks to tackle multiple areas in the Maltese Aquaculture sector grouped under regulatory, operational, environmental and innovation.



3: Implementation and achievement

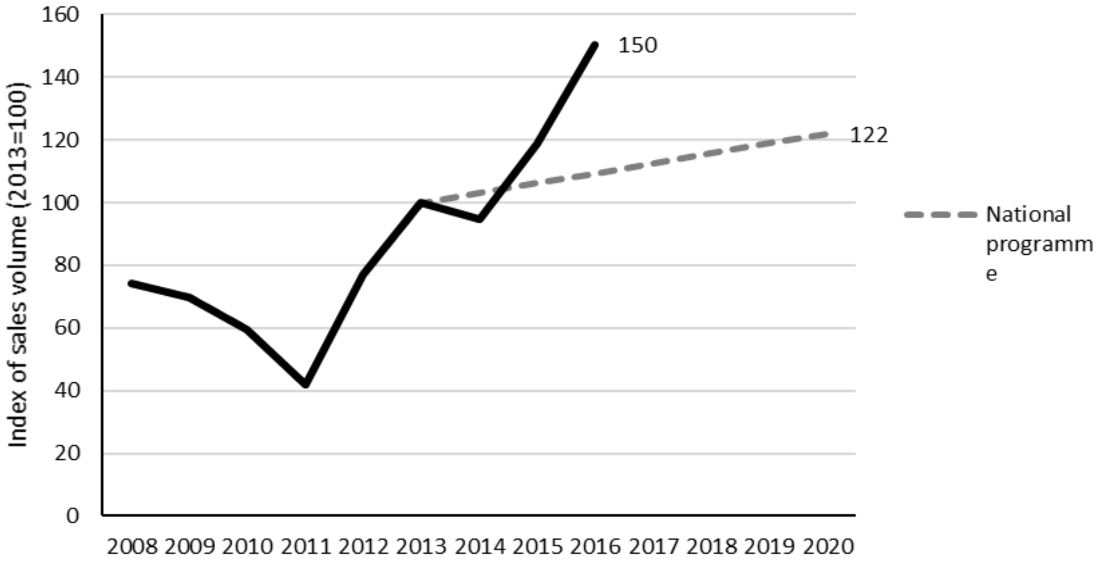
An interim review is envisaged after not less than 5 years from the strategy's adoption, to account for new technical, regulatory as well as economic developments in the sector, as necessary and relevant.

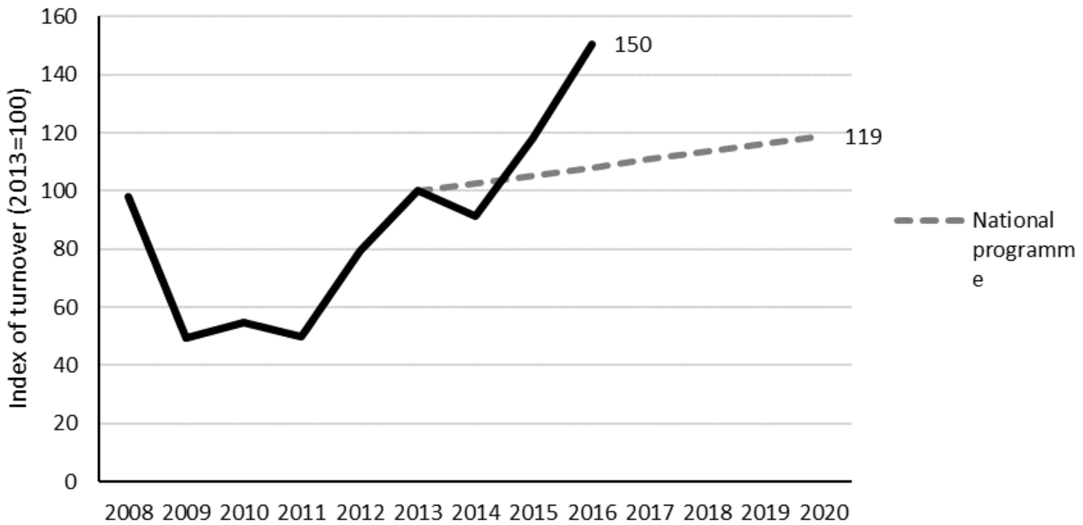
When observing 2016 and current trends with targets established in the Maltese National Aquaculture strategy for 2020, Malta is already in a very favourable position to achieve both its sector targets for production volume and production value. In 2016 data shows that production levels are 30% over the target, whereas production value is 37% over and above the target for 2020. Data from 2014, 2015 and 2016 shows that Malta is still circa halfway away from reaching the strategy's target of 5 000 tonnes produced yearly for closed cycle species.

Furthermore, with respect to the target of increasing the production volume for closed cycle species by 60%, data is currently showing a declining trend in the production volume of closed cycle species, implying that Malta is distancing slowly away from the original target. Nonetheless, it is important to keep in mind that data being reported covers up until 2016, a significant number of years remain for Malta to achieve these targets established in the National Aquaculture Strategy.

Considering the potential of the Maltese aquaculture and the possibility of innovation and technological advances within the sector, Malta is steering towards the right direction to achieve the targets established in the National Aquaculture Strategy. More information will shed more light on the latter, once the interim review is published.

An issue worth pointing out is that some current targets a one-year target specifying a particular percentage increase or amount (in terms of volume of production/sales) is not necessarily indicative of the actual progress of the sector and the progress being made by the national plan, variability of the sector should be taken into consideration. For this reason, it would be ideal that periodical targets are established in order to enable better monitoring and analysis of the progress of the national plan.





Note: Reported turnover converted to 2013 euros

5.4.14 The Netherlands

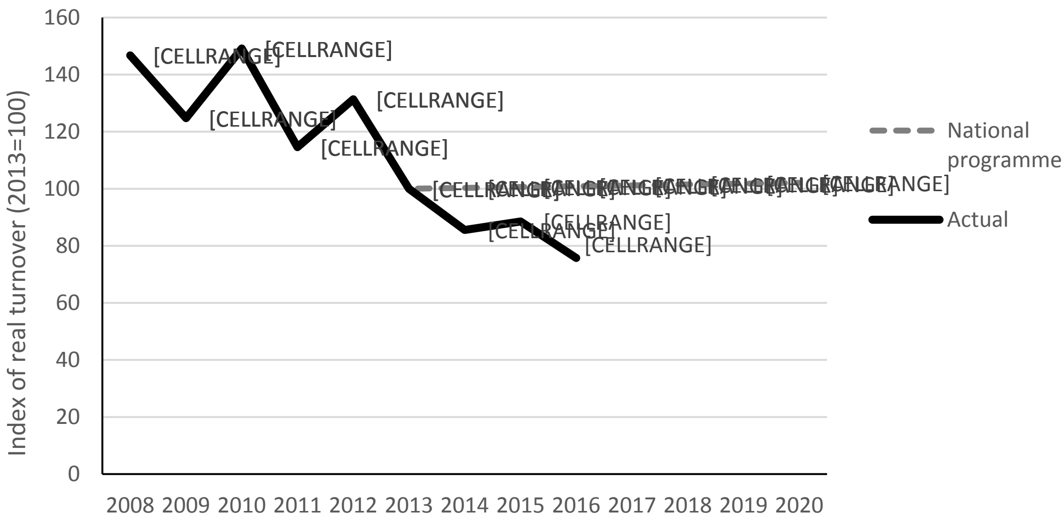
The Netherlands have foreseen a very modest grow of production. Because of the high labour costs and the limited space, The Netherlands will not be able to compete with aqua culture products from countries that are able to produce in an extensive way. Therefore, one has to focus on products for the niche markets and high grading the products. For mussels and oysters, new distribution channels could be found in EU countries. To achieve this, the Dutch aquaculture sector should enhance competitiveness, including by increasing and sharing knowledge of the processes.

The Netherlands focus on aquaculture systems that have minimum effects on the environment or even contribute to better environmental conditions. New chances will come up now that large windmill parks are being built on the North Sea. The combined use of wind energy, solar energy and aquaculture (algae, finfish, crustaceans and shellfish) is a goal that is focused on.

Several research projects are being carried out to investigate the possibilities of aqua culture on the North Sea and in the windmill parks. The governance supports these projects, in order to encourage and boost innovations in this field. Several difficulties have to be faced: rough conditions, multi-use of space, nutrition problems etc. etc.

The mussel sector is also in the midst of a transition towards collecting mussel seed with collectors instead of trawling for it in the Wadden Sea. This so called "Mosselconvenant" was agreed with all Wadden Sea stakeholders. Purpose of this covenant is to protect the natural mussel beds in the Wadden Sea. Finally, all mussel seed should be collected by using the mussel seed collectors. To enable this, new and better areas for growing the mussels should be allocated in order to increase the growth efficiency, as collector seed is more valuable and also more vulnerable. This allocation is foreseen for the years 2018-2019. All Dutch mussels are produced under ASC certification. The chain has become more integrated: larger companies that are fully integrated have taken over several smaller (family) companies. This trend is likely to continue.

Concerning the potential growth: as only a small growth was foreseen and the harvest may vary from year to year, no target on production volume was set. However, growing the mussels in the new and better areas should increase production. Focus lays more on producing for niche markets (oysters, yellowfin fish) and high grading the products by e.g. regional claims ("Mussels from Zealand", "Wadden Sea Oysters" etc.). Due to the fact that the mussel prices dropped since 2013, the real turnover is much lower than targeted, in 2016 even 24% lower than targeted. The drop in mussel prices is caused by a larger competition between the larger mussel farmers annex traders in The Netherlands, and by the availability of quality mussels from other MS.



Note: Reported data converted to 2013 euros

In The Netherlands, there is a good cooperation between the producers and the research institutes. As result of this, the producers are being well supported in the field of enhancing the competitiveness and in the field of innovation. Wageningen University and Research has its own branch in Yerseke, the center of aqua culture in The Netherlands, which makes a very good cooperation between research and producers possible.

5.4.15 Poland

1: Overall goals for the national program

According to Multiannual national plan for the development of sustainable aquaculture (MNPA), production volume should increase by 53% to 61 thousand tonnes in 2020. Freshwater fish farming should maintain extensive production volume (carp) and over 100% growth of intensive production volume (trout) by 2020. Moreover, it is assumed to maintain the current area of production for extensive aquaculture (60 thousand ha of usable area) as a 'productive surface'. It is planned to initiate marine fish and mollusc farming by 2020.

Operational Programme "Fisheries and the Sea" 2014-2020 is a financial instrument contributing to the implementation of MNPA. The expected increase in production is lower than in MNPA and is 51.6 thousand tonnes by 2023 (including growth to 6.0 thousand tonnes from recirculation systems).

Multiannual national plan for the development of sustainable aquaculture (MNPA) and Operational Programme are presenting different aquaculture production growth forecasting. It is assumed that less production in a longer period is more realistic.

2: Planned measures and actions:

According to Multiannual national plan for the development of sustainable aquaculture (2014-2020) Poland will enhance aquaculture by:

- simplifying administrative procedures through modification of data collection systems to bring them into line with the EU standards and improving the capacity of both administration and aquaculture technical branches to promote and administer modern, innovative aquaculture.
- enhancing competitiveness through increased government-led promotion of fish products through the Fish Promotion Fund, increased profitability of extensive production farms by an average of 10%, development of the domestic market, increasing the supply level and doubling deliveries to processing sector (thanks to action taken by FPF) and financial support to encourage a bond between science and producers.
- coordinated spatial planning through maintaining the current area of production for extensive aquaculture (60 000 ha of usable area) as the 'productive surface'.

3: Implementation and achievement[28]

Simplify administrative procedures

Poland collects aquaculture data annually through the Public Statistics Research Programme (PBSP), which is sent to Eurostat. In addition, aquaculture data is collected by scientists and industry organisations but it varies from the official data. Poland simplifies administrative procedures by modifying data collection to be no different from the EU standards. Strategy is being applied in order to synchronise aquaculture data collection systems.

Enhance competitiveness

The Fish Promotion Fund has helped to promote agri-food products, which has contributed to an increase in the use of the EU funds for information and promotion programmes and for maintaining a positive foreign trade balance for agri-food products.

The Management Committee of the Fish Promotion Fund has adopted a promotion strategy for the Fund for 2018. As a result of more aquaculture investments, it is estimated that in few years, nationally produced aquaculture products will form 40-50% of the total Polish market supply of fish.

There are actions to increase by an average of 10% the profitability of extensive production farms through financial support for income diversification. Moreover, financial support is also being provided to encourage more collaboration between scientists and producers.

Coordinated spatial planning

As a result of activities falling under this objective, the surface area of fish ponds has been maintained and the area of production for extensive aquaculture has increased to more than 60 000 ha. At the end of 2016, the registered area of earth ponds monitored under the Public Statistics Research Programme was 62 142 ha.

4. Conclusions

For national growth objectives, it is assumed that less production in a longer period is more realistic. All goals to enhance competitiveness and improve coordinated spatial planning are on course to being fully achieved. The objective to simplify administrative procedures is expected to be partially completed by the 2020.

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[28] Based on materials from Ministry of Marine Economy and Inland Navigation.

5.4.16 Portugal

1: Overall goals for the national program

The Multiannual national plan for the development of sustainable aquaculture strategic for Portuguese aquaculture 2014-2020 (PEAP2014) aims to "increase and diversify the supply of products of national aquaculture, based on the principles of sustainability, quality and food safety, to meet consumer needs and contribute to local development and the promotion of employment" (PEAP2014, p. 35).

The PEAP2014-2020 establishes the national development guidelines for Portuguese aquaculture and its elaboration has as references to ENM 2013-2020 (National Maritime Strategy 2013-2020) and the Sustainable Development Strategy for European Aquaculture (SDSEA).

The objectives of PEAP2014-2020 are the "promotion of online activity with the growth of consumption" (ENM2013-2020, p. 1329) and "the balance and alignment of production with consumer needs" (PEAP2014-2020, p. 1). In the context of the Union's concerns it intends to bridge the growing gap between consumption and insufficient community production, "a differential that has been harvested through imports from third countries" (PEAP2014, p. 1).

It adopts as guiding principles the sustainable exploitation of resources, institutional involvement, enhanced quality and food security, and the maintenance and development of employment and quality of life. It intends with an articulated and integrated approach to find solutions that allow to overcome the main constraints of the national sector, meeting what is advocated with the new financial instrument for the common Fisheries Policy (CFP), the fund European Maritime Affairs and Fisheries (EMFF).

Twelve objectives in total have been formulated in the multiannual national plan for the aquaculture sector of Portugal (three for the first Strategic Priority of the Guidelines (Axis A - SP 1- simplification of administrative processes), three for Axis B - SP 2 - facilitating access to space and water, three for Axis C - SP 3 - strengthening the Competitiveness and three for Axis C - SP 4 - promote a level playing field for EU operators).

2: Planned measures and actions:

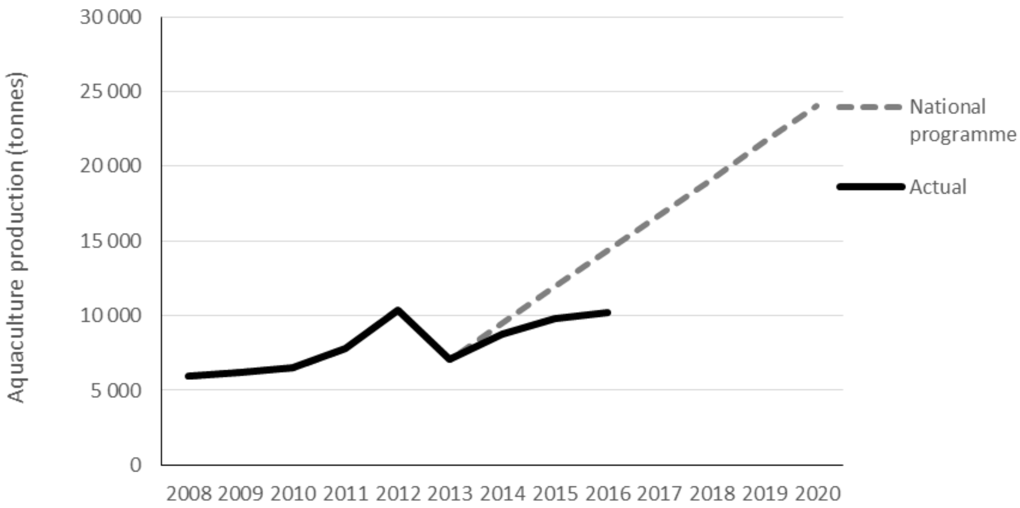
The actions specified in strategic action axes "to facilitate administrative procedures" and "facilitate the access to space and water" are in progress, having already completed the main regulatory initiatives. In the case of the Axis A, the development of electronic platform is underway and is expected to be completed by the end of 2018. With respect to the axis B, new specific areas have been identified for open ocean aquaculture production. Based on the methodology used for the Plan of Situation for the National Maritime Space, (PSOEM), is in progress the Plan for Aquaculture in Brackish Waters and Coastal Lagoons (PAqAT).

3: Implementation and achievement

In terms of progress, to date today, the majority of the objectives are on track to being achieved by 2020. Legislative changes are recent, yet the simplification of administrative procedures is on track to being achieved and a number of areas have been created for aquaculture production. Co-financed investments to enhance competitiveness have only recently been approved and will require multiannual implementation.

Most of the actions of the Operational Programme (OP) 2014-2020 are financed by the EMFF and can also be complemented by the financing of the other European Structural and Investment Funds (ESI), established in the Partnership Agreement and Cooperation European for Regions.

The MAR2020 programme, includes relevant instruments in terms of strengthening the competitiveness of aquaculture regulated all support measures relating to the sustainable development of aquaculture. It is expected that by the end of 2023 global aquaculture production reaches the 25 000 tonnes.



5.4.17 Slovenia

1: Overall goals for the national program

Main objectives of Slovenian OP 2014-2020 are Technological development, innovation and knowledge transfer, competitiveness and viability of aquaculture small and medium-sized enterprises (SMEs) including improvement of safety or working conditions, protecting and restoring aquatic biodiversity, enhancing aquaculture-related ecosystems, promoting resource-efficient aquaculture, providing professional training and lifelong learning.

National Growth Objectives;

- Production volume from 1 155 (2012) tonnes to 2 420 tonnes in 2020 (110% increase).
- Production value from 3.1 million (2012) euro to 4.9 million euro in 2023 (58% increase).
  - Freshwater fish farming 64% increase in volume by 2020
  - Marine fish farming 131% increase in volume by 2020
  - Mollusc farming 222% increase in volume by 2020

In the Slovenian Operational Programme for 2014-2020 the emphasis is primarily on freshwater aquaculture. The main objectives in marine aquaculture are to;

- increase the production of shellfish to 1 000 tonnes,
- and production of marine fish to 120 tonnes.

Key objective of Slovenian OP for fresh water aquaculture;

- Increase volume, value and net profit of aquaculture production; in cold water volume to a 1 000 tonnes per year, warm water volume 300 tonnes per year, increased GVA per employee to a €25 000 per year, total value of production to a €1.8 million per year and net profit to a €180 000;
- Increase organic aquaculture and recirculation systems; five fish farms with capacity more than 10 tonnes per year, total production of 500 tonnes per year;
- Support environmental services;
- Create and maintain employment; increase number of total employees to 180.

2: Planned measures and actions:

Simplify administrative procedures:

- The regulations for aquaculture in Slovenia are stricter than in other EU Member States. Increased access to information and faster permitting procedures are to be developed to support the growth in production.

Enhance competitiveness:

- ● The country plans to increase production and environmentally-friendly production by implementing measures for innovation, investments in increased production, developing new forms of income and added value, improved management of aquaculture installations and human capital, transition to eco-management, promoting animal health and welfare, management of aquaculture stock, and the development and implementation of local development strategies.

Coordinated spatial planning:

- ● A study will be prepared for areas identified as being most suitable for development of aquaculture in terms of spatial potential, water quality and nature conservation.

3: Implementation and achievement

Slovenia collecting the economic and social data just for the marine aquaculture so in the future will not be able fully assess whether the objectives have been achieved or not.

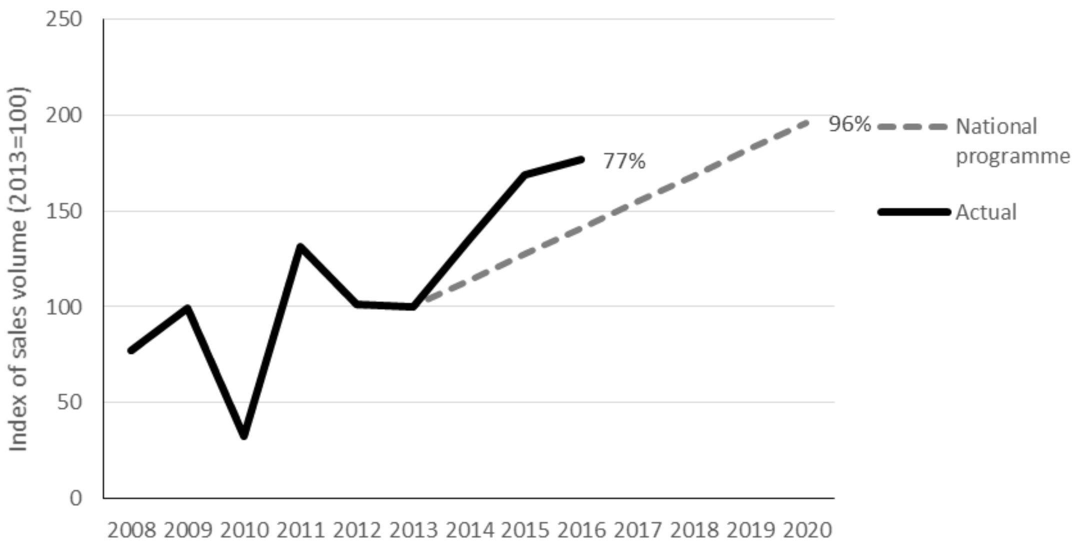
What part of the plans has been implemented and what goals have been achieved so far (2018)?

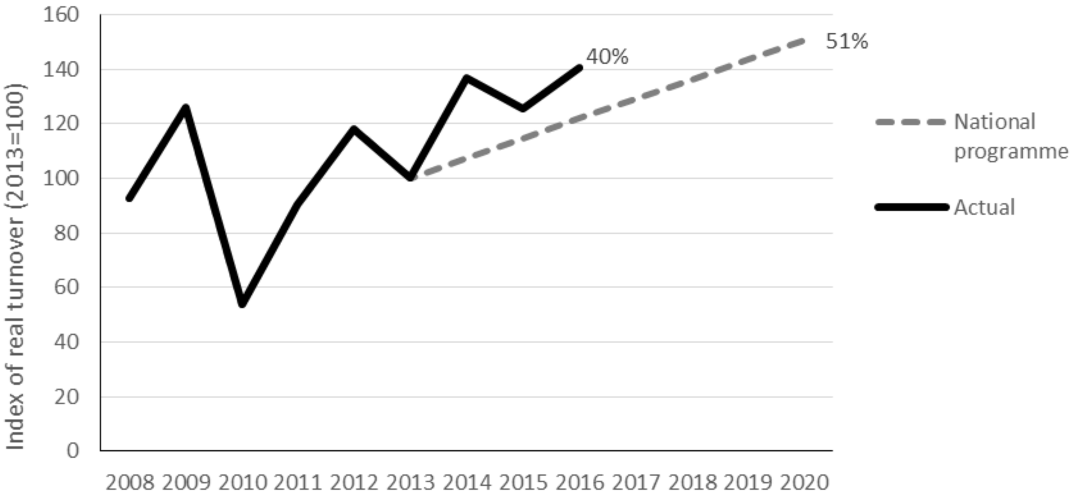
- Increased volume in production of shellfish for 97% from 2012-2016 (from 330 tonnes to 650 tonnes)

Assess the potential growth and whether the goals will be achieved in 2023?

Future development of Slovenian marine aquaculture is strongly conditioned by the small size of the Slovenian Sea. In 2007, three larger areas were designated for marine aquaculture in Slovenian territorial waters that were subsequently separated into 22 plots, for which concessions were granted for the use of marine water in 2009. It is expected that these plots will not be able to expand, due to the use of Slovenian territorial waters for other purposes. All Slovenian maritime fish and shellfish farms are currently operating at about 60% of their capacity. In the future we can expect increasing production to maximum capacity and then stagnation of Slovenian marine aquaculture. The production volume of marine fish and shellfish in 2016 was 27 tonnes (55 tonnes of marine fish in 2015) and 650 tonnes, respectively. On the basis of the data presented it can be assumed, at least for shellfish, that the objectives of Slovenian OP are realistically achievable.

Figures show an actual growth of production and growth predicted in OP in terms of sales volume and turnover





Note: Reported data converted to 2013 euros

5.4.18 Spain

Following the guidelines stated by the Commission in COM(2013) 299 Final Spain implemented the strategic plan for de development of National aquaculture in 2014. An effort in coordination across National and Regional governments was required since the administration of water resources relays on the Regional authorities.

1: Overall goals for the national program

The Spanish strategic plan attempts for an increase in production of 20% in volume and 26% in value during the period between 2012 to 2020. Growth expectations differ by main segments. Freshwater fish farming is expected to grow by 27% in volume, marine fish farming by 32% and shellfish farming by 17%. In order to fulfill these expectations a set of 8 strategic objectives have been proposed in line with the four pillars defined in the guidelines provide by the Commission.

2: Planned measures and actions:

The first pillar, simplify administrative procedures, is covered by one strategic objective consisting in the simplification of the administrative procedures and harmonization of the legal framework across the Regions. The second pillar, securing sustainable development and growth of aquaculture through coordinated spatial planning is also covered in one strategic goal consisting in improvement of spatial planning and selection of new farm locations. Four strategic goals were proposed on regard the third pillar, enhance the competitiveness of EU aquaculture. These goals include reinforcement of environmental aspects, promote animal safety and welfare, reinforcement of competitiveness through R+D+I, and support and improvement of existing training tools. Finally, promotion of processing marketing and internationalization, along with improvement in the awareness of farmed products value by mean of communication campaigns. Further, these strategic goals were divided into 541 specific actions to be undertaken during the implementation period. 38 of these actions are projected at the National level while the other 503 are to be implemented at regional level.

3: Implementation and achievement

A total 274 actions, representing 51%, were under execution in the period 2015 to 2017. According to the level of coverage, 87% of the actions at the National level and 48% at regional level are currently being implemented. There is a fair expectancy that all actions will be undertaken and concluded in time. However, although these actions will, unquestionably, benefit the development of National aquaculture, a direct link between the actions projected in the plan and the goals in terms of production and value is unclear. Production goals are not specified in the description nor in the control plan for the different actions. It is difficult to assess whether any shock in production or prices is a result of the actions taken. On this regard, total aquaculture production had increased 27% since the beginning of the implementation to 2016. This is more than the 20% expected increase proposed in the strategic plan. However, the question on whether this is a circumstantial growth, or a result of the actions undertaken remains uncertain. Considering the main aquaculture segments, growth in production between 2013 and 2015 was 14% for marine finfish (expected 32%), 33% for shellfish (expected 17%) and 3% for freshwater fish (expected 27%). The high growth rate in the shellfish industry is mainly due to the recovery of production in 2014 after severe persistence of red tidal in Galicia during 2013 rather than any action taken within the plan.

5.4.19 United Kingdom

1: National Growth objectives (2014-2020)

- Aquaculture production volume: "Aspirational" target to increase total by 24% to 254 000 tonnes via a 22% increase in finfish and 33% increase in shellfish
- Aquaculture production value: Increase total by 23% to €958 million

2: Planned measures and actions:

a) Simplifying administrative procedures: Develop codes of good practice supporting the regulatory framework; develop smarter regulation; simplify consenting procedures through joined-up regulation
b) Coordinating spatial planning: Prepare regional Marine Plans identifying "*aquaculture production areas for priority development*"
c) Enhancing competitiveness & Levelling the playing field: Improve communication, knowledge exchange, introduction of new technology and techniques.

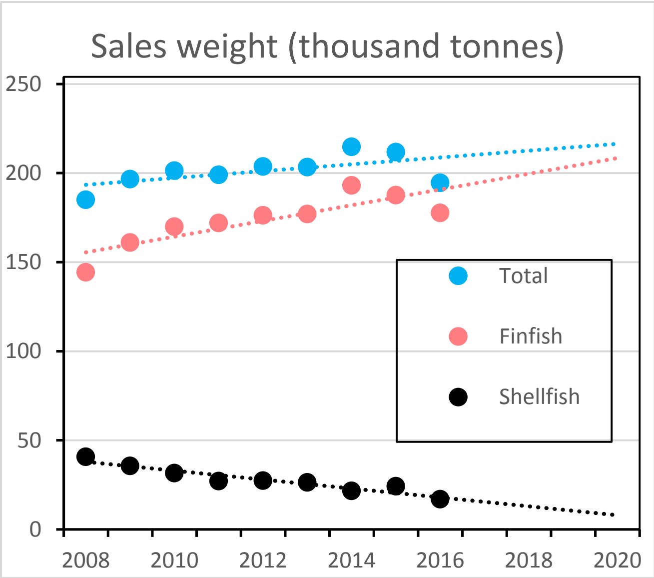
3: Implementation

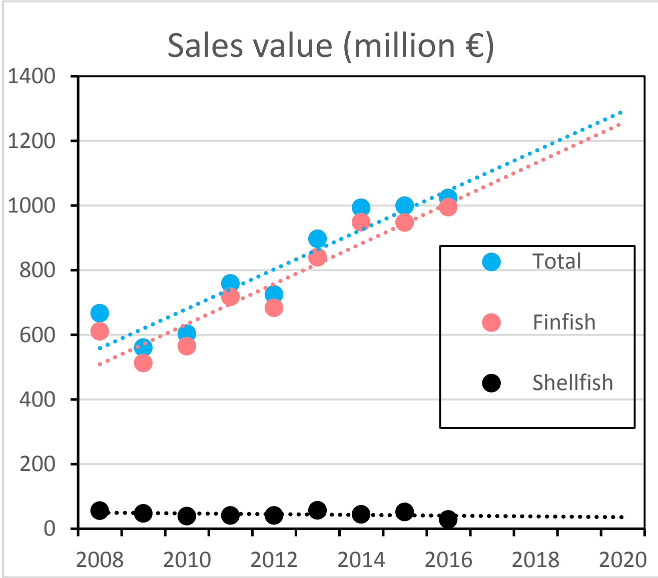
a) Code of good practice for Scottish finfish aquaculture[29]; Technical Standard for Scottish Finfish Aquaculture[30]; Aquaculture Regulatory Toolbox for England[31]
b) Potential aquaculture areas in marine plans –What they mean for potential new aquaculture businesses and their relationship with Marine Protected Areas (MPAs)[32]
c) Scottish Aquaculture Innovation Centre[33]; UK Aquaculture Initiative[34]; Scotland's Aquaculture website[35]; SARF targeted research[36]

4: Achievement of goals

- Aquaculture production volume trends: not on target due to shortfall in shellfish production.
  - Finfish: Trends driven by salmon. Although decreased between 2013/4 and 2015/6, if positive long-term trend (2008-2016) continues, on target for growth objective (216 000 tonnes).
  - Shellfish: Trends driven by mussel. Negative long-term trend indicates target (35 000 tonnes) shortfall.
- Aquaculture production value trends: Target of €958 million met in 2014 and since exceeded, albeit without accounting for inflation. Largely attributable to 17% increase in unit value (€/tonne) of salmon.

[29] http://thecodeofgoodpractice.co.uk/chapters/
[30] https://beta.gov.scot/binaries/content/documents/govscot/publications/publication/2015/06/technical-standard-scottish-finfish-aquaculture/documents/00479005-pdf/00479005-pdf/govscot:document/?inline=true
[31] http://www.seafish.org/industry-support/aquaculture/aquaculture-regulatory-toolbox-for-england
[32] http://www.seafish.org/media/1800920/_marine_plan_aquaculture_areas_clarification_final_approved_defra_31.1.18.pdf
[33] http://scottishaquaculture.com/
[34] https://bbsrc.ukri.org/funding/filter/uk-aquaculture-collaborative-projects/
[35] http://aquaculture.scotland.gov.uk/
[36] http://www.sarf.org.uk/projects/


Sales weight (thousand tonnes)
250
200
150
100
50
0
2008
2010
2012
2014
2016
2018
2020
Total
Finfish
Shellfish


Sales value (million €)
1400
1200
1000
800
600
400
200
0
2008
2010
2012
2014
2016
2018
2020
Total
Finfish
Shellfish

6 TRANSITION BETWEEN DCF AND EUMAP REGULATIONS

The data collection framework is currently in a transition period moving from DCF to EU MAP. In principle data submitted for the aquaculture data call is based on data collected according to the national operational program for 2017, which should follow the new EU MAP regulation. However, this time it has been optional for the MS to provide data according to the old DCF regulation and definitions or those laid down in the EU MAP. Most of the MS provided data according to the DCF regulation; nevertheless, some MS provided data according to the new regulation for 2016 or both years 2015 and 2016.

There are some differences in the new regulation compared to the old relate to the economic variables requested and specifically concerning the new segmentation on aquaculture production techniques that has been changed radically. It has therefore been a challenge to obtain consistent and comparable time series for countries providing both DCF and EUMAP data concerning the segmentation on aquaculture production techniques, which further have influenced on the consistency and comparability of the time series for the EU level.

In this chapter the expert group reviewed the main changes in the economic variables and the segmentation on aquaculture production techniques between DCF and the new EUMAP. Furthermore, the impact on comparability and consistence was assessed. The expert group furthermore propose further action to overcome the issues of non-consistency between the two programs.

MS which provided data in the format requested under EUMAP:

- For 2015 and 2016: Bulgaria, Finland, Latvia, Malta and UK
- For 2016: Italy and Sweden

MS which provided data in both formats:

- For 2015 and 2016: Croatia, Germany and Greece

MS which did not deliver data due to the new threshold implemented under the EUMAP.

- For 2015 and 2016: Cyprus and Poland
- For 2016: Estonia

The rest of the MS provided data as requested under the DCF; with the exception of landlocked countries (not part of the DCF/EUMAP): Austria, Czech Republic, Hungary, Luxembourg and Slovakia, and countries where marine aquaculture is non-existent or very small: Belgium and Lithuania. In addition, Romanian data could not be used because it was submitted after the deadline (on the last day of the EWG meeting).

Environmental and Social data:

Only two countries provided environmental data on medicines and one country on mortalities. It has therefore been agreed with DG MARE that data on environment is not presented and analyzed within this report.

Social data was not submitted under this data call and are therefore not discussed within this report.

This section is divided into a section on economic variables and a section on segmentation.

6.1 Economic variables

Concerning the economic variables, the following was observed:

Comparing the data collection on economic variables there have not been significant alterations shifting from DCF to EUMAP.

Table 6.1: DCF variables compared to EUMAP variables

	DCF variables		EUMAP variables
1	Turnover	1	Gross sales (Total)
2	Subsidies	10	Subsidies: Operating subsidies
3	Other income	2	Other income
4	Total income		= (1+2+10)
5	Wages and salaries	3	Wages and salaries
6	Imputed value of unpaid labour	4	Imputed value of unpaid labour
7	Energy costs	5	Energy costs
8	Raw material costs: Livestock costs	6	Raw material costs: Livestock costs
9	Raw material costs: Feed costs	7	Raw material costs: Feed costs
10	Repair and maintenance	8	Repair and maintenance
11	Other operational costs	9	Other operational costs
		11	Subsidies: Subsidies in investments
12	Depreciation of capital	12	Consumption of fixed capital
13	Financial costs, net		= (15 -14)
		14	Financial income
		15	Financial expenditures
14	Extraordinary costs, net		
15	Total value of assets	13	Total value of assets
16	Net Investments	16	Net Investments
17	Debt	17	Debt
18	Raw material volume: Livestock	18	Raw material weight: Livestock used
19	Raw material volume: Feed	19	Raw material weight: Fish feed used
20	Total sales volume	20	Total weight of sales
21	Male employees		
22	Female employees		
23	Total employees	21	Persons employed
24	Male FTE		
25	Female FTE		
26	FTE	22	Persons employed: FTE
		23	Unpaid labour
		24	Unpaid labour: FTE
		25	Number of hours worked by employees and unpaid labour
27	Number of enterprises <=5 employees	26	Number of enterprises <=5 employees
28	Number of enterprises 6-10 employees	27	Number of enterprises 6-10 employees
29	Number of enterprises >10 employees	27	Number of enterprises >10 employees

More specifically the following changes have been implemented to be able to keep the time trend without data breaks.

DCF variable (4) "Total income" is now calculated as the sum of (1) "Gross sales", (2) "Other income" and (10) "Operating subsidies".

DCF Variables (13) "Financial cost, net" is now calculated as (15) "Financial expenditures" subtracted (14) "Financial income".

The following variables are not collected anymore and as such a time trend cannot be sustained.

Within the economic variables employees and FTE's divided on gender is no longer requested under the EUMAP, which have effect on the reporting on issue related to gender. The table and graphs for countries reporting data according to EUMAP will therefore not show the division of male and female for the years 2015 and 2016. The division of gender is reported under the social variables, which was not requested in this data call.

The variable (14) "Extraordinary costs, net" is not collected; however, this variable has not been of great importance to the former reports. However, an extraordinary item in accounting is an event or transaction that is considered abnormal, not related to ordinary company activities, and unlikely to recur in the foreseeable future. Therefore, in case there are extraordinary incomes or costs it may compromise the analysis of the sector performance if these are recorded as other income or costs.

Table 6.2: Changes in calculating indicators under EU-MAP within the EWG 18-19 report.

INDICATORS	EUMAP
Mean wage	("wages and salaries" + "Imputed value of unpaid labour")/("persons employed: FTE" + **unpaid labour: FTE**) if "persons employed: FTE" ≠ 0; ("wages and salaries" + "Imputed value of unpaid labour")/"persons employed" if "persons employed: FTE" = 0
Total income	"Gross sales (Total)" + "**Subsidies: Operating subsidies**" + "Other income"
Total operating costs	"Wages and salaries" + "Imputed value of unpaid labour" + "Energy costs"+ "Repair and maintenance" + "Other operational costs"+ "Raw material costs: feed costs" + "Raw material costs: livestock costs") (calculated only if "wages and salaries" + "Imputed value of unpaid labour" ≠ 0)
Gross Value Added	**"Gross sales (Total)"** + "Other income" - "Total operating costs" + "wages and salaries" + "Imputed value of unpaid labour"
Operating cash flow	**"Gross sales (Total)"** + "Other income" + "Subsidies: Operating subsidies" + Subsidies in investments - "Total operating costs"
EBIT	"Operating cash flow" - **"Consumption of fixed capital"**
Net profit	"Earnings before interest and tax" + **"Financial income" - "Financial expenditures"**
Capital productivity (%)	"Gross Value Added" / "Total value of assets"
Return on Investment (%)	"Earnings before interest and tax" / "Total value of assets"
Future Expectation Indicator (%)	("Net Investments" - "Consumption of fixed capital") / "Total value of assets"
Labour productivity	"Gross Value Added" / "persons employed: FTE" **+ imputed labour: FTE** . If "persons employed: FTE" ≠ 0; "Gross Value Added" / "persons employed" if "persons employed: FTE" = 0.
GVA to revenues	GVA / (gross sales + other income)
OCF margin	OCF / ("Gross sales (Total)" + "Other income" + "**Subsidies: Operating subsidies" + Subsidies in investments**)
EBIT margin	EBIT / ("Gross sales (Total)" + "Other income" + "**Subsidies: Operating subsidies" + Subsidies in investments**)
net profit margin	net profit / ("Gross sales (Total)" + "Other income" + "**Subsidies: Operating subsidies" + Subsidies in investments**)

6.2 Segmentation on species and production technique

The reasoning for the introduction of a new segmentation in the EUMAP was an alignment of the segmentation with Eurostat segments. DCF includes the following farming techniques; "hatcheries and nurseries", "on-growing", "combined" and "cages". These are now replaced in EUMAP with the following farming techniques, which are included in the (Eurostat) statistical Regulation (EC) No 762/2008 on aquaculture; "ponds", "tanks and raceways", "enclosures and pens", "cages", "recirculation systems", "other methods" as well as "combined" and "hatcheries and nurseries".

Another argument for changing the segmentation was that the end users could get better and more precise economic information on different types of production system when using the new classification. This would allow for a more precise economic comparison between different production systems in terms of productivity and efficiency, which could be valuable for the end users.

The expert group made the following observation regarding the new segmentation:

For the EUMAP a new segmentation has been implemented containing both new species and new production technologies. Each species can now be divided into 6-8 or more production technologies.

- A problem using many different segments when the overall populations of enterprises are small is that it can create confidentiality issues when reporting. Furthermore, some countries are not able to split up data into the recommended EUMAP segments. This is for example the case for the DCF group "combined production", which covers enterprises with own hatcheries nurseries production.
- Without a common understanding (guidelines) it may be difficult for the reporters of the data to translate the former DCF segment into the new EUMAP segments. The development of common guidelines containing recommendations to where to place such enterprise for all countries would be valuable for both data reporters and end users. A recommendation could be to place such enterprises in a kind of a default group, such as, ex. "species other methods". This is especially relevant for the finfish production, where "on growing" and "combined production" should be placed in new segments, whereas the shellfish segment seems more aligned between the two programs.
- In the EUMAP there are 150 potential combinations of species and techniques, which from the expert group point of view seems to be an over implementation of new segments. Some of these segments seems to be added by mistake and others segments seems not to be relevant do to the fact that there is no reporting of production in these segment in EUROSTAT for the past 3 years (2014-2016). Furthermore, not all production techniques seem relevant for all species.
- The EUMAP data collection segmentation does not include microalgae. However, the production methods currently listed under seaweed production are in some cases specific for microalgae production. It is therefore recommending that the segmentation categories listed for algae are revised for future regulatory framework in order to include microalgae and adapt appropriate production methods for the algae sector.

6.3 Conclusions

EWG 18 19 recommends, that the tasks of drawing up a common set of guidelines is undertaken by the PG-ECON containing the following issues.

For the segmentation:

- Transformation/translation between DCF and EUMAP
- Dealing with confidentiality issues
- Recommendation to a default group for fresh water species – ("species other methods")
- Consistency of the segmentation practices between countries.
- Identification of relevant and irrelevant production techniques/segments

For data submission:

- The possibility of reporting data from all EU countries within the format of EUMAP from either 2015 or 2016 and forward to have identical years for the data break between programs.
- The format on segmentation should be changed only showing relevant segments.
- When reporting the segments, it should be possible to leave the lines without any data "empty". In the format today the MS must report zeros in all lines (up till 150 lines) even though they do not have any data for these segmentation lines.

7 CONTACT DETAILS OF EWG-18-19 PARTICIPANTS

[1] - Information on EWG participant's affiliations is displayed for information only. In any case, Members of the STECF, invited experts, and JRC experts shall act independently. In the context of the STECF work, the committee members and other experts do not represent the institutions/bodies they are affiliated to in their daily jobs. STECF members and experts also declare at each meeting of the STECF and of its Expert Working Groups any specific interest which might be considered prejudicial to their independence in relation to specific items on the agenda. These declarations are displayed on the public meeting's website if experts explicitly authorized the JRC to do so in accordance with EU legislation on the protection of personnel data. For more information: http://stecf.jrc.ec.europa.eu/adm-declarations

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8 ANNEXES

8.1 Annex I: Data collected under DCF an EU-MAP

This report represents a transition from the former DCF program to the new and the recently implemented EU-MAP program. For this data call Member States was allowed to report either under the DCF or under the EU-MAP. Below the requested variable and segmentations for both programs are listed.

8.1.1 Parameters requested under the DCF

The economic variables to be collected for the aquaculture industry sector under the Data Collection are specified in section A of the Chapter IV and in Appendix X of Commission Decision 2010/93/EC of the 18th of December 2010, on Adopting a multiannual Community programme pursuant to Council Regulation (EC) No 199/2008 establishing a Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy.

Table 8.1: DCF data requirements

Variable Group	Variable	Unit
Income	Turnover	Euro
	Subsidies	Euro
	Other Income	Euro
	Total Income	Euro
Personnel Costs	Wages and salaries	Euro
	Imputed value of unpaid labour	Euro
Energy Costs	Energy Costs	Euro
Raw Material Costs	Livestock costs	Euro
	Feed costs	Euro
Repair and maintenance Costs	Repair and maintenance	Euro
Other operational Costs	Other operational costs	Euro
Capital Costs	Depreciation of capital	Euro
	Financial Costs, net	Euro
Extraordinary Costs	Extraordinary Costs, net	Euro
Capital Value	Total Value of Assets	Euro
Investments	Net Investments	Euro
Debt	Debt	Euro
Raw Material Volume	Livestock	Tonne
	Fish Feed	Tonne
Total volume	Total sales volume	Tonne
Employment	Male employees	Number
	Female employees	Number
	Total employees	Number
	Male FTE	Number
	Female FTE	Number
	Total FTE	Number

Number of enterprises	less or equal than 5 employees	Number
	6-10 employees	Number
	more or equal than 11 employees	Number

Following DCF the statistical unit for the aquaculture data collection is defined as enterprise, which is the lowest legal entity for accounting purposes. The population refers to enterprises whose primary activity is defined according to the EUROSTAT definition under NACE Code 05.02: 'Fish Farming'. More detailed definitions of parameters can be found in the glossary (section 8.2). Data is requested to be reported by segment and in National totals. Segments are defined as a combination of the main species cultured and the technology used for their production.

8.1.2 Parameters requested under the EUMAP

Under the provisions of Council Regulation 2017/1004, there are requested the economic variables for the aquaculture sector detailed in Table 7 of the Commission Decision (EU) 2016/1251. Member States are invited to submit listed data following the segmentation set out in Table 9 of the Commission implementing decision (EU) 2016/1251.

Table 8.2: EUMAP data requirements

Variable Group	**Variable**	**Unit**
Income	Gross sales (total)	Euro
	Operating Subsidies	Euro
	Other Income	Euro
Personnel Costs	Wages and salaries	Euro
	Imputed value of unpaid labour	Euro
Energy Costs	Energy Costs	Euro
Raw Material Costs	Livestock costs	Euro
	Feed costs	Euro
Repair and maintenance Costs	Repair and maintenance	Euro
Other operational Costs	Other operational costs	Euro
Capital Costs	Consumption of fixed capital	Euro
	Financial Income	Euro
	Financial Expenditure	Euro
Capital Value	Total Value of Assets	Euro
Investments	Net Investments	Euro
	Subsidies in investments	Euro
Debt	Debt	Euro
Raw Material Weight	Livestock used	Kg
	Fish Feed used	Kg
Total volume	Total weight of sales	Kg
Employment	Persons employed	Number
	Persons employed FTE	Number
	Number of hours worked by employees and unpaid labour	Number
	Unpaid labour	Number

	Unpaid labour FTE	Number
Number of enterprises	Less or equal than 5 employees	Number
	6-10 employees	Number
	More or equal than 11 employees	Number

8.2 Annex II: Glossary of variables and indicators reported under the DCF and EUMAP

8.2.1 Parameters requested under the DCF

Turnover:

"Turnover" comprises the totals invoiced by the observation unit during the reference period, and this corresponds to market sales of goods or services supplied to third parties.

Turnover includes all duties and taxes on the goods or services invoiced by the unit with the exception of the VAT invoiced by the unit vis-à-vis its customer and other similar deductible taxes directly linked to turnover.

It also includes all other charges (transport, packaging, etc.) passed on to the customer, even if these charges are listed separately in the invoice. Reduction in prices, rebates and discounts as well as the value of returned packing must be deducted. Income classified as other operating income, financial income and extraordinary income in company accounts is excluded from turnover. Operating subsidies received from public authorities or the institutions of the European Union are also excluded (Structural Business Statistics (SBS) Code 12 11 0, Commission Regulation (EC) No 2700/98).

Subsidies:

"Subsidies" are the financial assistance received from public authorities or the institutions of the European Union which are excluded from turnover.

It includes direct payments, e.g. compensation for stopping trading, refunds of fuel duties or similar lump sum compensation payments; excludes social benefit payments and indirect subsidies, e.g. reduced duty on inputs such as fuel or investment subsidies.

Other income:

"Other income" refers to other operating income included in company accounts which are excluded from turnover; income coming from other activities than aquaculture, e.g. the licensing of ponds for recreational fishery purposes.

Wages and salaries:

"Wages and salaries" is equivalent to "Personnel costs" on the Structural Business Statistics.

"Personnel costs" are defined as the total remuneration, in cash or in kind, payable by an employer to an employee (regular and temporary employees as well as home workers) in return for work done by the latter during the reference period. Personnel costs also include taxes and employees' social security contributions retained by the unit as well as the employer's compulsory and voluntary social contributions.

Personnel costs are made up of:

- wages and salaries
- employers' social security costs

All remuneration paid during the reference period is included, regardless of whether it is paid on the basis of working time, output or piecework, and whether it is paid regularly or not. Included are all gratuities, workplace and performance bonuses, ex gratia payments, thirteenth month pay (and similar fixed bonuses), payments made to employees in consideration of dismissal, lodging, transport, cost of living and family allowances, commissions, attendance fees, overtime, night work etc. as well as taxes, social security contributions and other amounts owed by the employees and retained at source by the employers. Also included are the social security costs for the employer. These include employer's social security contributions to schemes for retirement pensions, sickness, maternity, disability, unemployment, occupational accidents and diseases, family allowances as well as other schemes. These costs are included regardless of whether they are statutory, collectively agreed, contractual or voluntary in nature. Payments for agency workers are not included in personnel costs. (Structural Business Statistics (SBS) Code 13 31 0, Commission Regulation (EC) No 2700/98).

Wages and salaries: Wages and salaries are defined as "the total remuneration, in cash or in kind, payable to all persons counted on the payroll (including homeworkers), in return for work done during the accounting period." regardless of whether it is paid on the basis of working time, output or piecework and whether it is paid regularly or not. Wages and salaries include the values of any social contributions, income taxes, etc. payable by the employee even if they are actually withheld by the employer and paid directly to social insurance schemes, tax authorities, etc. on behalf of the employee. Wages and salaries do not include social contributions payable by the employer. Wages and salaries include: all gratuities, bonuses, ex gratia payments, "thirteenth month payments", severance payments, lodging, transport, cost-of-living, and family allowances, tips, commission, attendance fees, etc. received by employees, as well as taxes, social security contributions and other amounts payable by employees and withheld at source by the employer. Wages and salaries which the employer continues to pay in the event of illness, occupational accident, maternity leave or short-time working may be recorded here or under social security costs, depending upon the unit's accounting practices. Payments for agency workers are not included in wages and salaries. (Structural Business Statistics (SBS) Code 13 32 0, Commission Regulation (EC) No 2700/98).

Social security costs: Employers' social security costs correspond to an amount equal to the value of the social contributions incurred by employers in order to secure for their employees the entitlement to social benefits. Social security costs for the employer include the employer's social security contributions to schemes for retirement pensions, sickness, maternity, disability, unemployment, occupational accidents and diseases, family allowances as well as other schemes. Included are the costs for all employees including homeworkers and apprentices. Charges are included for all schemes, regardless of whether they are statutory, collectively agreed, contractual or voluntary in nature. Wages and salaries which the employer continues to pay in the event of illness, occupational accident, maternity leave or short-time working may be recorded here or under wages and salaries, dependent upon the unit's accounting practices. (Structural Business Statistics (SBS) Code 13 33 0, Commission Regulation (EC) No 2700/98).

Imputed value of unpaid labour:

Unpaid workers normally refer to persons who live with the proprietor of the unit and work regularly for the unit, but do not have a contract of service and do not receive a fixed sum for the work they perform. This is limited to persons who are not included on the payroll of another unit as their principal occupation.

Thus, imputed value of unpaid labour estimates the value of the salaries that these unpaid workers would have received if their work was remunerated.

The chosen methodology to estimate this imputed value of unpaid labour should be explained by the Member State in their national programme.

Energy costs:

“Energy costs” corresponds to the “Purchases of energy products (in value)” on the Structural Business Statistics.

Purchases of all energy products during the reference period should be included in this variable only if they are purchased to be used as fuel. Energy products purchased as a raw material or for resale without transformation should be excluded. This figure should be given in value only. (Structural Business Statistics (SBS) Code 20 11 0, Commission Regulation (EC) No 2700/98).

Livestock costs:

Livestock costs should correspond to the variable livestock volume.

In the Structural Business Statistics, it is included inside 13 11 0 “Total purchases of goods and services”.

Feed costs:

Feed costs include the purchasing costs of the feed during the reference period. The feed costs should correspond to feed volume.

In the Structural Business Statistics, it is included inside 13 11 0 “Total purchases of goods and services”.

Repair and maintenance:

Under repair and maintenance there should be included the costs incurred to bring an asset back to its earlier condition or to keep the asset operating at its present condition (as opposed to improving the asset).

On the Structural Business Statistics is included inside 13 11 0 “Total purchases of goods and services”.

Other operational costs:

Other operating costs should comprise outsourcing costs, property or equipment rental charges, the cost of raw materials and supplies that cannot be held in the inventory and have not been already specified (i.e. water, small items of equipment, administrative supplies, etc.), insurance premiums, studies and research costs, external personnel charges, fees payable to intermediaries and professional expenses, advertising costs, transportation charges, travel expenses, the costs of meetings and receptions, postal charges, bank charges (but not interest on bank loans) and other items of expenditure.

On the Structural Business Statistics is included inside 13 11 0 “Total purchases of goods and services”.

Depreciation of capital:

Depreciation refers to the decline in value of the assets. In accounting, it is used as the allocation of the cost of tangible assets to periods in which the assets are used, in order to reflect this decline in their value.

The chosen methodology to allocate these costs over periods should be explained in the national programme. ESA (6) 6.02 to 6.05 European System of Accounts 1995 (Regulation (EC) No 2223/96, Regulation (EC) No 1267/2003, Eurostat ESA 1995 manual).

Financial costs, net:

"Financial costs, net" should be calculated as costs, coming from financial activity of the enterprise, minus the financial income.

Extraordinary costs, net:

"Extraordinary costs, net" is the difference between "Extraordinary charges" and "Extraordinary income".

"Extraordinary income" and "Extraordinary charges" are the income and costs that arise otherwise than in the course of the company's ordinary activities (Article 29 of the Fourth Council Directive 78/660/EEC of 25 July 1978).

Total value of assets:

This parameter corresponds to the Balance sheet total of the Structural Business Statistics and the Capital value in the European System of Accounts.

Balance sheet total consists of the sum of items 1 to 16 of the asset side of the balance sheet or of the sum of items 1 to 14 of the liability side of the balance sheet. (Structural Business Statistics (SBS) Code 43 30 0, Commission Regulation (EC) No 2700/98).

Capital value is the total accumulated value of all net investments in the enterprise at the end of the year. ESA 7.09 to 7.24 European System of Accounts 1995 (Regulation (EC) No 2223/96, Regulation (EC) No 1267/2003, Eurostat ESA 1995 manual).

Net Investments:

"Net investments" refers to the difference between Purchase (Gross investment in tangible goods) and Sale (Sales of tangible investment goods) of assets during the year.

Gross investment in tangible goods is the Investment during the reference period in all tangible goods. Included are new and existing tangible capital goods, whether bought from third parties or produced for own use (i.e. Capitalised production of tangible capital goods), having a useful life of more than one year including non-produced tangible goods such as land. The threshold for the useful life of a good that can be capitalised may be increased according to company accounting practices where these practices require a greater expected useful life than the one-year threshold indicated above.

All investments are valued prior to (i.e. gross of) value adjustments, and before the deduction of income from disposals. Purchased goods are valued at purchase price, i.e. transport and installation charges, fees, taxes and other costs of ownership transfer are included.

Own produced tangible goods are valued at production cost. Goods acquired through restructurations (such as mergers, take-overs, break-ups, split-off) are excluded. Purchases of small tools which are not capitalised are included under current expenditure. Also included are all additions, alterations, improvements and renovations which prolong the service life or increase the productive capacity of capital goods. Current maintenance costs are excluded as is the value and current expenditure on capital goods used under rental and lease contracts. Investment in intangible and financial assets are excluded. Concerning the recording of investments where the invoicing, delivery, payment and first use of the good may take place in different reference periods, the following method is proposed as an objective:

i) Investments are recorded when the ownership is transferred to the unit that intends to use them. Capitalised production is recorded when produced. Concerning the recording of investments made in identifiable stages, each part-investment should be recorded in the reference period in which they are made.

In practice this may not be possible and company accounting conventions may mean that the following approximations to this method need to be used:

i) investments are recorded in the reference period in which they are delivered,

ii) investments are recorded in the reference period in which they enter into the production process,

iii) investments are recorded in the reference period in which they are invoiced,

iv) investments are recorded in the reference period in which they are paid for.

Gross investment in tangible goods is based on Gross investment in land (15 12 0) + Gross investment in existing buildings and structures (15 13 0) + Gross investment in construction and alteration of buildings (15 14 0) + Gross investment in machinery and equipment (15 15 0). (Structural Business Statistics (SBS) Code 15 11 0, Commission Regulation (EC) No 2700/98).

Sales of tangible goods includes the value of existing tangible capital goods, sold to third parties. Sales of tangible capital goods are valued at the price actually received (excluding VAT), and not at book value, after deducting any costs of ownership transfer incurred by the seller. Value adjustments and disposals other than by sale are excluded. (Structural Business Statistics (SBS) Code 15 21 0. Commission Regulation (EC) No 2700/98).

Debt:

Financial assets created when creditors lend funds to debtors, either directly or through brokers, which are either evidenced by non-negotiable documents or not evidenced by documents.

Short-term loans: loans whose original maturity is normally one year or less, and in exceptional cases two years at the maximum, and loans repayable on demand.

Long-term loans: loans whose original maturity is normally more than one year, and in exceptional cases more than two years at the minimum.

“Debts” account for provisions and long- and short-term debt (STECF meeting SGECA 06-01).

Livestock (volume):

Volume of livestock purchased during the reference period. The livestock volume should correspond to the livestock cost.

Fish feed (volume):

Volume of feed purchased during the reference period. The feed volume should correspond to feed cost.

Volume of sales:

The volume of sales should correspond to the variable on turnover value. In case of hatcheries and nurseries conversion factors from numbers to tonnes should be stated in the national programmes.

Number of persons employed (Total employment):

This indicator refers to the number of people employed (including full-time and part-time employees) (SGECA-09-03). It corresponds to the Number of people employed of the Structural Business Statistics.

The number of persons employed is defined as the total number of persons who work in the observation unit (inclusive of working proprietors, partners working regularly in the unit and unpaid family workers), as well as persons who work outside the unit who belong to it and are paid by it (e.g. sales representatives, delivery personnel, repair and maintenance teams). It includes persons absent for a short period (e.g. sick leave, paid leave or special leave), and also persons on strike, but not those absent for an indefinite period. It also includes part-time workers who are regarded as such under the laws of the country concerned and who are on the pay-roll, as well as seasonal workers, apprentices and home workers on the pay-roll. The number of persons employed excludes manpower supplied to the unit by other enterprises, persons carrying out repair and maintenance work in the enquiry unit on behalf of other enterprises, as well as those on compulsory military service. Unpaid family workers refer to persons who live with the proprietor of the unit and work regularly for the unit, but do not have a contract of service and do not receive a fixed sum for the work they perform. This is limited to those persons who are not included on the payroll of another unit as their principal occupation. (Structural Business Statistics (SBS) Code 16 11 0, Commission Regulation (EC) No 2700/98).

The number of employees should be reported by gender.

FTE National:

"FTE national" is the number of employees converted in full time equivalents (calculation methodologies vary between countries).

It corresponds to the "Number of employees in full time equivalent units" of the Structural Business Statistics.

The number of employees converted into full time equivalents (FTE). Figures for the number of persons working less than the standard working time of a full-year full-time worker, should be converted into full time equivalents, with regard to the working time of a full-time full-year employee in the unit. Included in this category are people working less than a standard working day, less than the standard number of working days in the week, or less than the standard number of weeks/months in the year. The conversion should be carried out on the basis of the number of hours, days, weeks or months worked. (Structural Business Statistics (SBS) Code 16 14 0, Commission Regulation (EC) No 2700/98).

Reporting the number of FTE national by gender is optional.

Number of enterprises:

The "Number of enterprises" parameter corresponds to a count of the number of enterprises active during at least a part of the reference period (SGECA-09-03).

A count of the number of enterprises registered to the population concerned in the business register corrected for errors, in particular frame errors. Dormant units are excluded. This statistic should include all units active during at least part of the reference period. (Structural Business Statistics (SBS) Code 11 11 0, Commission Regulation (EC) No 2700/98).

Both definitions are similar. However, there are often some divergences with Eurostat data. This is mostly due to the use of the Veterinary list (which is necessary to trade with food products) to update the business register and so companies that are dormant or focusing on other products have been excluded.

Moreover, under the DCF regulation, the number of companies should be disaggregated by the number of persons employed (in ≤5; 6-10 and >10 FTE) (Structural Business Statistics (SBS) Code 16 14 0, Commission Regulation (EC) No 2700/98).

8.2.2 Indicators calculated under the DCF

Average wage:

The average salary or mean wage estimates the salary an employee working full time is receiving on this sector. It includes the salaries themselves, the social security costs and imputed value of unpaid labour.

Mean wage = (Wages and salaries + Imputed value of unpaid labour) / FTE

Gross Value Added (GVA):

Gross Value Added measures the contribution of the sector to the economy.

The Gross Value Added indicator calculated in this report is similar, but does not fully correspond to the Value added at factor cost of the Structural Business Statistics.

Value added at factor cost as defined in the Structural Business Statistics is the gross income from operating activities after adjusting for operating subsidies and indirect taxes. It can be calculated from turnover, plus capitalised production, plus other operating income, plus or minus the changes in stocks, minus the purchases of goods and services, minus other taxes on products which are linked to turnover but not deductible, minus the duties and taxes linked to production. Alternatively, it can be calculated from gross operating surplus by adding personnel costs. Income and expenditure classified as financial or extra-ordinary in company accounts is excluded from value added. Value added at factor costs is calculated "gross" as value adjustments (such as depreciation) are not subtracted. (Structural Business Statistics (SBS) Code 12 15 0, Commission Regulation (EC) No 2700/98).

Thus, Gross Value Added is calculated on this report as:

GVA = Turnover + Other Income – Energy costs – Livestock costs – Feed costs - Repair and maintenance - Other Operational costs.

GVA to Revenues:

Gross value added to revenue ratio - indicates the share of revenue that contributes to the economy through factors of production (returns to labour and returns to capital). Indicator is calculated as the ratio between gross value added and revenue (the sum of Turnover and Other Income). Expressed as a percentage.

$$GVA\ to\ Revenue = \frac{GVA}{Turnover + Other\ Income}100\%$$

Earnings Before Interest and Tax (EBIT):

“Earnings before interest and taxes (EBIT)” or “Operating profit” is a measure of a firm's profitability that excludes interest and income tax expenses.

EBIT = Turnover + Other Income + Subsidies – Energy costs – Wages and salaries - Imputed value of unpaid labour - Livestock costs – Feed costs – Repair and maintenance – Other Operational costs – Depreciation of capital

Net profit:

“Net profit” is a measure of a firm's profitability that includes the results of financial activity of the enterprise.

Net profit = EBIT – Financial_costs_net

Net profit margin:

Net profit margin is a measure of the economic performance of a sector or enterprise expressed in relative terms. It is a difference between total income and all incurred costs (operating, capital and financial). Expressed in percentage.

$$Net\ profit\ margin = \frac{Net\ profit}{Total\ Income} 100\%$$

Return on Investment (ROI):

Return on investment is a performance measure to evaluate the profitability (efficiency) of an investment.

During the SGECA-10-04 meeting it was decided that it was more appropriate to calculate the Return on Investment using the “Earnings Before Interest and Tax (EBIT)”, rather than the Net profit.

$$ROI = \frac{EBIT}{Total\_Value\_of\_Assets} * 100\%$$

Running Cost to Turnover Ratio (in %):

This indicator shows how much of the turnover (income) is consumed by production costs.

Running cost to turnover ratio = (Energy costs + Wages and salaries + Livestock costs + Feed costs + Repair and maintenance + Other Operational costs) x 100 / Turnover

Earnings Before Interest and Tax (EBIT) to Revenue ratio:

“Earnings before interest and taxes (EBIT) to revenue ratio” measures the margin of the companies’ profit. Expressed in percentages.

$$EBIT\ to\ Revenue = \frac{EBIT}{Turnover + Other\ Income} * 100\%$$

Labour productivity (by FTE or Employee):

Labour productivity is calculated as the average output per worker or per time unit. It can be calculated as Gross Value Added (GVA) divided by Full Time Equivalents (FTE). This indicator describes the value added to the economy from the activity, in this case the value added to the economy by one FTE.

$$Labour\_productivity = \frac{GVA}{FTE}$$

When a MS cannot report the level of employment in FTEs, the number of employees is used as a second best alternative. However, this alternative compromises the comparison and should be clearly stated in the report.

Capital productivity:

Capital productivity is calculated as the average output per unit of capital. It can be calculated as Gross Value Added (GVA) divided by Capital value (total value of assets) in percentage. The indicator describes the value added to the economy by one unit of capital.

$$Capital\ productivity = \frac{GVA}{Total\ value\ of\ assets} 100\%$$

Future Expectations of the Industry indicator:

The indicator "Future Expectations of the Industry" can be interpreted as a proxy for the industry's intent to remain in the market in the medium/long term. If investment minus depreciation is positive, it has the meaning that the sector is allocating resources to increase its production capacity, and therefore it expects to remain in the market to recover the cost of the investment. If investment minus depreciation is close to zero, it could be interpreted as an indicator that the sector is only wishing to maintain its production capacity in the future, and that it is not planning to expand. The third case is where the sector is not even covering its depreciation costs, thus disinvesting with the possible intention to reduce its presence in the market in the future. Therefore, this indicator would be used to approximate the industry's investing behaviour in the future and it has been considered useful by the experts.

$$FEI = \frac{(Net\_investment - Depreciation)}{Total\_value\_of\_\ assets} * 100\%$$

Change 2016-15:

The indicator of the relative change in corresponding indicators compared to the previous year. Expressed in percentage, calculated as following:

$$Change\ 2016 - 15 = \frac{(X_{2016} - X_{2015})}{X_{2015}} * 100\%$$

Development 2016/(2008-2015):

The indicator of the relative change in corresponding indicators compared to the average of previous years for which the data are available (usually 2008-2015). The estimate is showing the long term development of the corresponding indicator. Expressed in percentages, calculated as following:

$$Development\ 2014/(2008 - 2013) = \frac{(X_{2014} - average(X_{2008,}X_{2009,}X_{2010,}X_{2011,}X_{2012,}X_{2013,}X_{2014,}X_{2015}))}{average(X_{2008,}X_{2009,}X_{2010,}X_{2011,}X_{2012,}X_{2013,}X_{2014,}X_{2015,})} * 100\%$$

8.2.3 Parameters requested under the EUMAP

Gross sales (total): corresponds to the DCF variable "Turnover".

Operating Subsidies: corresponds to the DCF variable "Subsidies". It refers to direct payments which general government or the institutions of the European Union make to resident producers. (ESA D.3).

Other Income: corresponds to the DCF variable “Other Income”.

Wages and salaries: corresponds to the DCF variable “Wages and salaries”.

Imputed value of unpaid labour: corresponds to the DCF variable “Imputed value of unpaid labour”.

Energy Costs: corresponds to the DCF variable “Energy Costs”.

Livestock costs: corresponds to the DCF variable “Livestock costs”.

Feed costs: corresponds to the DCF variable “Feed costs”.

Repair and maintenance: corresponds to the DCF variable “Repair and maintenance”.

Other operational costs: corresponds to the DCF variable “Other operational costs”.

Consumption of fixed capital: corresponds to the DCF variable “Depreciation of capital”.

Total Value of Assets: corresponds to the DCF variable “Total Value of Assets”.

Net Investments: corresponds to the DCF variable “Net Investments”.

Debt: corresponds to the DCF variable “Debt”.

Livestock used: corresponds to the DCF variable “Livestock”.

Fish Feed used: corresponds to the DCF variable “Fish Feed”.

Total weight of sales: corresponds to the DCF variable “Total sales volume”.

Persons employed: corresponds to the DCF variable “Total employees”.

Persons employed FTE: corresponds to the DCF variable “Total FTE”.

Less or equal than 5 employees: corresponds to the DCF variable “Less or equal than 5 employees”.

6-10 employees: corresponds to the DCF variable “6-10 employees”.

More or equal than 11 employees: corresponds to the DCF variable "More or equal than 11 employees".

Financial Expenditure minus Financial Income: corresponds to the DCF variable "Financial Costs, net".

Subsidies in investments: Direct payments which general governments or the institutions of the European Union make to resident producers to finance all or part of the costs of their acquiring assets related to the company.

Number of hours worked by employees and unpaid labour: The aggregate number of hours worked by the persons employed and the unpaid labour during the reference period.

Unpaid labour: Number of workers that have not received compensation in the form of wages, salaries, fees, gratuities, piecework pay or remuneration in kind.

Unpaid labour FTE: The number of workers that have not received compensation in the form of wages, salaries, fees, gratuities, piecework pay or remuneration in kind converted into full time equivalent jobs (FTE).

8.2.4 Indicators calculated under the EUMAP

Average wage:

The average salary or mean wage estimates the salary an employee working full time is receiving on this sector. It includes the salaries themselves, the social security costs and imputed value of unpaid labour.

Under the EUMAP, the indicator is calculated as follows:

Mean wage = (Wages and salaries + Imputed value of unpaid labour) / (Persons employed FTE + Unpaid labour FTE)

$$\text{Mean wage} = \frac{Wages\ and\ salaries\ +\ Imputed\ value\ of\ unpaid\ labour}{Persons\ employed\ FTE\ +\ Unpaid\ labour\ FTE}$$

Gross Value Added (GVA):

Gross Value Added measures the contribution of the sector to the economy.

The Gross Value Added indicator calculated in this report is similar, but does not fully correspond to the Value added at factor cost of the Structural Business Statistics.

Value added at factor cost as defined in the Structural Business Statistics is the gross income from operating activities after adjusting for operating subsidies and indirect taxes. It can be calculated from turnover, plus capitalised production, plus other operating income, plus or minus the changes in stocks, minus the purchases of goods and services, minus other taxes on products which are linked to turnover but not deductible, minus the duties and taxes linked to production. Alternatively, it can be calculated from gross operating surplus by adding personnel costs. Income and expenditure classified as financial or extra-ordinary in company accounts is excluded from value added. Value added at factor costs is calculated "gross" as value adjustments (such as depreciation) are not subtracted. (Structural Business Statistics (SBS) Code 12 15 0, Commission Regulation (EC) No 2700/98).

Thus, under the EUMAP, the indicator is calculated as follows:

GVA = Gross sales (total) + Other Income – Energy costs – Livestock costs – Feed costs - Repair and maintenance - Other Operational costs.

GVA to Revenues:

Gross value added to revenue ratio - indicates the share of revenue that contributes to the economy through factors of production (returns to labour and returns to capital). Indicator is calculated as the ratio between gross value added and revenue (the sum of Turnover and Other Income). Expressed as a percentage. Under the EUMAP, Gross Value Added is calculated as under the DCF:

$$GVA\ to\ Revenue = \frac{GVA}{Turnover + Other\ Income} 100\%$$

Earnings Before Interest and Tax (EBIT):

"Earnings before interest and taxes (EBIT)" or "Operating profit" is a measure of a firm's profitability that excludes interest and income tax expenses. Under the EUMAP, the indicator is calculated as follows:

EBIT = Turnover + Other Income + Operating Subsidies + Subsidies on Investments – Energy costs – Wages and salaries - Imputed value of unpaid labour - Livestock costs – Feed costs – Repair and maintenance – Other Operational costs – Consumption of fixed capital.

Net profit:

"Net profit" is a measure of a firm's profitability that includes the results of financial activity of the enterprise. Under the EUMAP, the indicator is calculated as follows:

Net profit = EBIT – (Financial Expenditure - Financial Income)

Net profit margin:

Net profit margin is a measure of the economic performance of a sector or enterprise expressed in relative terms. It is a difference between total income and all incurred costs (operating, capital and financial). Expressed in percentage. Under the EUMAP, the indicator is calculated as follows:

$$Net\ profit\ margin = \frac{Net\ profit}{Turnover\ +\ Other\ Income\ +\ Operating\ Subsidies\ +\ Subsidies\ on\ Investments} 100\%$$

Return on Investment (ROI):

Return on investment is a performance measure to evaluate the profitability (efficiency) of an investment.

During the SGECA-10-04 meeting it was decided that it was more appropriate to calculate the Return on Investment using the "Earnings Before Interest and Tax (EBIT)", rather than the Net profit. Under the EUMAP, the indicator is calculated as under the DCF:

$$ROI = \frac{EBIT}{Total\_Value\_of\_Assets} * 100\%$$

Running Cost to Turnover Ratio (in %):

This indicator shows how much of the turnover (income) is consumed by production costs. Under the EUMAP, the indicator is calculated as under the DCF:

Running cost to turnover ratio = (Energy costs + Wages and salaries + Livestock costs + Feed costs + Repair and maintenance + Other Operational costs) x 100 / Turnover

Earnings Before Interest and Tax (EBIT) to Revenue ratio:

"Earnings before interest and taxes (EBIT) to revenue ratio" measures the margin of the companies' profit. Expressed in percentages. Under the EUMAP, the indicator is calculated as follows:

$$EBIT\ to\ Revenue = \frac{EBIT}{Turnover\ +\ Other\ Income\ +\ Operating\ Subsidies\ +\ Subsidies\ on\ Investments} * 100\%$$

Labour productivity (by FTE or Employee):

Labour productivity is calculated as the average output per worker or per time unit. It can be calculated as Gross Value Added (GVA) divided by Full Time Equivalents (FTE). This indicator describes the value added to the economy from the activity, in this case the value added to the economy by one FTE. Under the EUMAP, the indicator is calculated as follows:

$$Labour\_productivity = \frac{GVA}{Persons\ employed\ FTE\ +\ Unpaid\ labour\ FTE}$$

When a MS cannot report the level of employment in FTEs, the number of employees is used as a second best alternative. However, this alternative compromises the comparison and should be clearly stated in the report.

Capital productivity:

Capital productivity is calculated as the average output per unit of capital. It can be calculated as Gross Value Added (GVA) divided by Capital value (total value of assets) in percentage. The indicator describes the value added to the economy by one unit of capital. Under the EUMAP, the indicator is calculated as under the DCF:

$$Capital\ productivity = \frac{GVA}{Total\ value\ of\ assets} 100\%$$

Future Expectations of the Industry indicator:

The indicator "Future Expectations of the Industry" can be interpreted as a proxy for the industry's intent to remain in the market in the medium/long term. If investment minus depreciation is positive, it has the meaning that the sector is allocating resources to increase its production capacity, and therefore it expects to remain in the market to recover the cost of the investment. If investment minus depreciation is close to zero, it could be interpreted as an indicator that the sector is only wishing to maintain its production capacity in the future, and that it is not planning to expand. The third case is where the sector is not even covering its depreciation costs, thus disinvesting with the possible intention to reduce its presence in the market in the future. Therefore, this indicator would be used to approximate the industry's investing behaviour in the future and it has been considered useful by the experts. Under the EUMAP, the indicator is calculated as follows:

$$FEI = \frac{(Net\_investment - Consumption\ of\ fixed\ capital)}{Total\_value\_of\_\ assets} * 100\%$$

8.3 Annex III: Data coverage

As foreseen in the Regulation No 2017/1004, the Commission asked Member States to provide aggregated scientific data from within their National Data Collection programs to support scientific advice.

The data requested refers to 2015 and 2016; while previous years (2008-2014) could be submitted or resubmitted as full annual data sets in cases where the already submitted data are considered incomplete or require correction. Data requested for 2015 and 2016, in accordance within their National Data Collection programs, can be provided under the provisions of Regulation 199/2008 and/or under the Regulation 2017/1004.

Under the provisions of Regulation 199/2008, there were requested the same variables as requested in the previous year's data call: Income (turnover, subsidies and other income), Personnel costs (Wages and salaries of staff and Imputed value of unpaid labour), Energy costs, Raw material costs (livestock costs and feed costs), Repair and maintenance costs, Other operational costs, Capital costs (depreciation of capital and financial costs), Extraordinary costs, Capital value, Net Investments, Debt, Raw material volume (livestock and feed), Volume of sales, Employment (Number of persons employed, gender and FTE national) and number of enterprises pertaining to the EU aquaculture sector. Moreover, turnover and volume of sales need to be detailed by species. The segmentation is set out in the Appendix XI of the Commission Decision.

Under the provisions of Regulation 2017/1004, there were requested the economic variables for the aquaculture sector detailed in Table 7 of the Commission implementing decision (EU) 2016/1251. In particular, Income (gross total sales, operating subsidies and other income), Personnel costs (Wages and salaries of staff and Imputed value of unpaid labour), Energy costs, Raw material costs (livestock costs and feed costs), Repair and maintenance costs, Other operational costs, Capital costs (consumption of fixed capital), Financial income and Financial expenses, Capital value, Net Investments, Subsidies in investments, Debt, Raw material volume (livestock and feed), Volume of sales, Employment (Number of persons employed their FTE national, number of unpaid labour and their FTE, and Number of hours worked by employees and unpaid labour) and number of enterprises pertaining to the EU aquaculture sector. Moreover, turnover and volume of sales need to be detailed by species. The segmentation set out in Table 9 of the Commission implementing decision (EU) 2016/1251. In addition, Member States were requested to provide the Environmental variables for the aquaculture sector detailed in Table 8 of the Commission implementing decision (EU) 2016/1251.

Collection of data for freshwater species is not mandatory. However, if collected, Member States are invited to provide it during the data call.

The Data Collection Framework (DCF) and EU-MAP requires data quality assurance by Member States. Data checks were performed by the JRC through the comprehensive analysis of the data submitted and by experts attending the meeting to elaborate this report. As a consequence of these data checks data has been resubmitted by some of the countries after the deadline and during the EWG meeting. There have also been a few countries resubmitting data after the meeting due to discrepancies found during the meeting.

This was the sixth call for data on aquaculture. Although there was an improvement in the overall data quality compared to the previous calls, there are still issues that have to be improved by the Member States, the coverage has decreased from previous data call.

Under the DCF and EUMAP, the submission of marine aquaculture data is compulsory, while the submission of inland freshwater aquaculture data is voluntary. Therefore, aquaculture data is not requested from the landlocked countries Austria, Czech Republic, Hungary, Luxembourg and Slovakia.

Belgium and Lithuania only produce aquaculture products in freshwater, hence these MS did not carry out any data collection within the DCF and EUMAP frameworks.

Cyprus and Poland did not provide data for 2015 and 2016, and Estonia for 2016 because their aquaculture production is below the thresholds set in the EUMAP regulation.

Romanian data could not be used because it was submitted after the deadline (on the last day of the EWG meeting). Dutch and Greek data were also submitted after the deadline, but before the EWG meeting, and so data could be checked and analysed in the report.

The data coverage by country and variable is presented in the Table . The table is showing partially missing data by country and on the National total level.

Table 8.3: Coverage of the data provided during the data calls at National total level 2008-2016 (Y = submitted).

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Bulgaria	Y	Y	Y	Y	Y	Y	Y	Y	Y
Croatia	Croatia was not part of the EU				Y	Y	Y	Y	Y
Cyprus	Y	Y	Y	Y	Y	Y	Y		
Denmark	Y	Y	Y	Y	Y	Y	Y	Y	Y
Estonia	Y	Y	Y	Y	Y	Y	Y	Y	
Finland	Y	Y	Y	Y	Y	Y	Y	Y	Y
France			Y	Y	Y	Y	Y	Y	Y
Germany	Y	Y	Y	Y	Y	Y	Y	Y	Y
Greece	The data collection program was interrupted					Y	Y	Y	Y
Ireland	Y	Y	Y	Y	Y	Y	Y	Y	Y
Italy	Y	Y	Y	Y	Y	Y	Y	Y	Y
Malta	Y	Y	Y	Y	Y	Y	Y	Y	Y
Netherlands	Y	Y	Y	Y	Y	Y	Y	Y	Y
Poland		Y	Y	Y	Y	Y	Y		
Portugal	Y	Y	Y	Y	Y	Y	Y	Y	Y
Romania		Y	Y	Y	Y	Y	Y		
Slovenia	Y	Y	Y	Y	Y	Y	Y	Y	Y
Spain	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sweden	Y	Y	Y	Y	Y	Y	Y	Y	Y
United Kingdom	Y	Y	Y	Y	Y	Y	Y	Y	Y
Latvia	Only freshwater aquaculture, not compulsory to report							Y	Y
Belgium	Only freshwater aquaculture, not compulsory to report								
Lithuania	Only freshwater aquaculture, not compulsory to report								
Austria	Not part of the DCF. Only freshwater aquaculture								
Czech Republic	Not part of the DCF. Only freshwater aquaculture								
Hungary	Not part of the DCF. Only freshwater aquaculture								
Slovakia	Not part of the DCF. Only freshwater aquaculture								
Luxembourg	Not part of the DCF. No aquaculture production								

In chapter 2 of this report an EU overview is presented based on national total level data and estimated values covering the missing data for some countries or missing data from some years (as shown in the Table above). A description of the methodology can be found in annex V.

In addition, the EU sector analysis in the chapter 3 is based on national aquaculture segment level data, which for each sector divided on production techniques and species produced. Missing data for some countries or missing data from some years can affect the results of the time series analysis. Thus, when reading this report, and in particular the EU overview in chapter 2 and the EU sector analysis in chapter 3, the numbers may not fully match.

Other relevant issues affecting quality and coverage of the data:

- Greece only submitted data for 2013 and 2014. 2014 Greek data was for the full aquaculture sector, while 2013 was for a part of it. Greece did not report the FTE variables (total FTE, male and female FTE) and the raw material volume: livestock for 2014.
- Croatia only submitted data from 2012 onwards because it became part of the EU only in 2013.
- Romania did not report 2008 data in previous aquaculture data calls, so 2008 data is also not available for Romania.
- France, Italy and the Netherlands submitted data for 2015 and 2016 on most of their aquaculture production, but not for all of their production.
- Slovenia only reported marine aquaculture production. Germany only reported by segments the marine aquaculture production.
- France provided a full set of economic variables on aquaculture segment level for 2010-2016 (missing 2008 and 2009), however there are missing variables for some minor segments.
- The United Kingdom started providing full datasets in 2011 and 2012 and significantly improved the quality of the data submitted. Most of economic variables are missing for the years 2008- 2010.
- Portugal submitted all data for the period 2009-16, but only partial data for 2008.
- The Netherlands did not submit employment data (total employment, as well as male and female employment for the whole period 2008-16).
- Spain submitted production and economic data by segment that was not matching. Corrected data was submitted after the meeting, and it could not be incorporated in the report.
- These and other data issues are further detailed under the data issues in each national chapter.

8.4 Annex IV: Quality and Coverage checking procedures on the data submitted under the 2018 aquaculture economic data call

Although the quality and coverage of the data reported under the Data Collection Framework (DCF) are a responsibility of the EU Member States, JRC (European Commission) has undertaken quality and coverage checking procedures on the data submitted, some carried out during the data uploading phase and some afterwards. The quality and coverage of the data has also been checked by national experts during the STECF EWG 18 19 meeting on the Economic Report of the EU aquaculture sector which took place in Italy, during the week 22 to 26 November 2018.

Aquaculture data submitted under the 2018 data call and used for the STECF report have been checked in four subsequent steps. This section provides a synthetic description of each of them. More information of the quality and coverage checking procedures undertaken on DCF aquaculture data are available in the JRC technical report available at:

http://datacollection.jrc.ec.europa.eu/

Step 1- Data checks before and during uploading procedure to the JRC/DCF database

Several data checks are already embedded in the excel templates which the Member States are required to use for uploading data on their national aquaculture sector. In specific cells of these files, the data entry is restricted to certain records (e.g. acceptable codes, value types and ranges).

Furthermore, during the data uploading procedure, a number of automatic syntactic checks are carried out on the data before it is accepted by the DCF database hosted by JRC. Syntactic checks are carried out without any specific knowledge of what the data contains or its meaning. They tell if the data is present or not and in the correct format. These checks automatically reject data that do not confirm to specific restrictions, such as ensuring textual data is validated against defined parameters lists. In addition, numeric data are checked to make sure they contain numbers and not strings. Member States receive immediate feedback when attempting to upload their data submissions.

Step 2 - Results of the data quality checks/analyses are assessed by JRC experts

Once the datasets with the aquaculture data are successfully uploaded by the Member States, JRC produces different analyses on the data submitted in order to facilitate the assessment of its quality and coverage. Some of these analyses are presented in interactive online dashboards created using the software Tableau. The same software is also used for analyses not specifically related to data quality, i.e. analyses on the structure and economic performance of the EU aquaculture sector and overviews of the uploading status of DCF aquaculture data.

All the analyses performed by JRC in Tableau are available in interactive online dashboards, which are refreshed every morning and are accessible (only after authentication), on the following link:

https://datacollection.jrc.ec.europa.eu/da/aqua/quality

Besides developing the checks and analyses, JRC experts actively participate in the analysis of their results. All quality issues (e.g. inconsistencies, outliers and missing data) concerning the data submitted, identified through the analyses performed in Tableau or with manual checks are listed by JRC in excel files, one for each MS, including the most relevant information concerning the problems identified (e.g. description of the problem, structural and economic indicators affected and assessed impact on the analyses of the final STECF report), together with comments and actions recommended by JRC to solve the issues.

Step 3 – National correspondents receive a list of data transmission issues and may resubmit revised data

The excel files listing the data quality issues (and including JRC experts' comments and opinions on the action to undertake) are sent to the national correspondents (each national correspondent receives information only about the country he/she represents).

MS are requested to consider the potential anomalies listed in the excel file, amend and re-submit the data as necessary. They are also requested to go over the quality analyses performed in order to detect additional (if any) problems and add them to the list. Finally, they are asked to provide feedback (i.e. whether or not the problem has been resolved, which actions have been taken and possible comments) in designated columns of the excel file.

Step 4 – The quality and coverage of the data have been checked by the STECF Expert Working Groups

In addition to being analysed by JRC's experts, the quality and coverage of aquaculture data submitted under the DCF is also checked by national fisheries experts during the STECF EWG meeting. Data submitted under the 2018 aquaculture economic data call has been checked during the EWG meeting 18 19 which took place during the week 22 to 26 January 2018.

At the beginning of the meeting, the experts received the excel files with the list of data transmission issues of the MS assigned to them, which also included for each specific issue comments by JRC and feedback sent by the MS when available. MS have been contacted whenever an inconsistency was found and the expert attending the meeting could not solve it by resubmitting data. Furthermore, all experts have been given access to the tableau dashboards. This has allowed them to visualise changes in the data whenever the MS have uploaded revised data during the meeting or submitted new templates.

The experts reported in the Data Transmission Monitoring Tool the relevant data coverage and quality issues that remained unsolved by the end of the STECF EWG.

8.5 Annex V: Methodology for construction of overall EU trends

Background

In order to produce a time series of the EU aquaculture sector for some key economic indicators, a number of steps needed to be taken. These steps are described for each indicator below. In general, the data techniques employed are to address issues with multiple data submission frameworks (i.e. through the DCF and the new EU MAP), instances of data gaps for particular years and/or indicators in Member State data submissions, and Member States that, due to their small aquaculture sector, are not required to submit data under the data collection framework. This report marks the first time this exercise has been undertaken and it is hoped that the methodology described here can be further developed in future reports. Other economic indicators such as GVA or profits proved too difficult to provide a reliable time series for as there are significant data gaps in input costs for major aquaculture producing Member States.

Total sales volume

The main data source for total sales volume is the submission of data by Member States through the DCF or EU MAP. Where there are data gaps, the most recent reporting year was adjusted based on the percentage change in FAO production data. For Member States that do not report data on total sales volume through the data collection framework for any year, FAO production data was taken directly. To include freshwater aquaculture that is not covered in the DCF or EU MAP, a direct data submission was included for Germany and FAO production was used for Poland. 74% of total EU sales volume comes from five Member States: Spain, France, Italy, the United Kingdom, and Greece.

The following table summarises the source and/or estimation methodology for total sales volume:

Source	2008	2009	2010	2011	2012	2013	2014	2015	2016
AUT	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO
BEL	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO
BGR	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
CYP	DCF	DCF	DCF	DCF	DCF	DCF	DCF	ΔFAO	ΔFAO
CZE	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO
DEU	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
DNK	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
ESP	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
EST	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	ΔFAO
FIN	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
FRA	ΔFAO	ΔFAO	DCF	DCF	DCF	DCF	DCF	DCF	DCF
GBR	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
GRC	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
HRV	ΔFAO	ΔFAO	ΔFAO	ΔFAO	DCF	DCF	DCF	DCF	DCF
HUN	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO
IRL	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
ITA	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	ΔFAO
LTU	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO
LVA	ΔFAO	ΔFAO	ΔFAO	ΔFAO	ΔFAO	ΔFAO	ΔFAO	EUMAP	EUMAP
MLT	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
NLD	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
POL	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO
PRT	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
ROU	ΔFAO	DCF	DCF	DCF	DCF	DCF	DCF	ΔFAO	ΔFAO
SLK	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO
SVN	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
SWE	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP

Turnover

The main data source for turnover is the submission of data by Member States through the DCF or EU MAP. Where there are data gaps, the most recent reporting year was adjusted based on the percentage change in FAO value of production data. For Member States that did not report turnover through the data collection framework, FAO data on value of production was taken directly. To include freshwater aquaculture that is not covered in the DCF or EU MAP, a direct data submission was included for Germany and FAO production value was used for Poland. 73% of total EU turnover comes from five Member States: the UK, France, Spain, Greece, and Italy.

In addition to reporting on the trend in nominal turnover (as in the rest of the report), an additional time series has been produced for turnover in real values by adjusting each Member States' turnover by its annual inflation rate as reported in Eurostat.

The following table summarises the source and/or estimation methodology for nominal and real turnover:

Source	2008	2009	2010	2011	2012	2013	2014	2015	2016
AUT	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO
BEL	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO
BGR	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
CYP	DCF	DCF	DCF	DCF	DCF	DCF	DCF	ΔFAO	ΔFAO
CZE	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO
DEU	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
DNK	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
ESP	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
EST	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	ΔFAO
FIN	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
FRA	ΔFAO	ΔFAO	DCF	DCF	DCF	DCF	DCF	DCF	DCF
GBR	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
GRC	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
HRV	ΔFAO	ΔFAO	ΔFAO	ΔFAO	DCF	DCF	DCF	DCF	DCF
HUN	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO
IRL	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
ITA	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	ΔFAO
LTU	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO
LVA	ΔFAO	ΔFAO	ΔFAO	ΔFAO	ΔFAO	ΔFAO	ΔFAO	EUMAP	EUMAP
MLT	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
NLD	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
POL	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO
PRT	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
ROU	ΔFAO	DCF	DCF	DCF	DCF	DCF	DCF	ΔFAO	ΔFAO
SLK	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO	FAO
SVN	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
SWE	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP

Number of enterprises

The main data source for the number of enterprises is the submission of data by Member States through the DCF or EU MAP. Where there are data gaps, the most recent reporting year was used. This is a different estimation methodology than sales volume and turnover (as previously described) as the number of enterprises is very stable and does not change significantly when there are changes in production volume or value.

For Member States that do not report any data on the number of enterprises through the data collection framework, the number of enterprises was estimated by applying the ratio of real turnover (as previously described) per enterprise calculated for DCF reporting Member States to the real turnover (as previously described) for the Member States without data on the number of enterprises. This is likely to be an underestimate of the number of enterprises as the Member States that are not covered though the DCF are likely to have lower productivity than the larger aquaculture producing Member States that are reporting data. This estimation technique was also applied to Germany to include their freshwater aquaculture. A direct data submission was used for Greece in 2016 as their enterprises in the DCF are measured as total units.

The following table summarises the source and/or estimation methodology for the number of enterprises:

Source	2008	2009	2010	2011	2012	2013	2014	2015	2016
AUT	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM
BEL	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM
BGR	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
CYP	DCF	DCF	DCF	DCF	DCF	DCF	DCF	CLOSESTYEAR	CLOSESTYEAR
CZE	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM
DEU	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM
DNK	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
ESP	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
EST	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	CLOSESTYEAR
FIN	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
FRA	CLOSESTYEAR	CLOSESTYEAR	DCF	DCF	DCF	DCF	DCF	DCF	DCF
GBR	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
GRC	CLOSESTYEAR	CLOSESTYEAR	CLOSESTYEAR	CLOSESTYEAR	CLOSESTYEAR	CLOSESTYEAR	CLOSESTYEAR	CLOSESTYEAR	DCF
HRV	CLOSESTYEAR	CLOSESTYEAR	CLOSESTYEAR	CLOSESTYEAR	DCF	DCF	DCF	DCF	DCF
HUN	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM
IRL	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
ITA	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	CLOSESTYEAR
LTU	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM
LVA	CLOSESTYEAR	CLOSESTYEAR	CLOSESTYEAR	CLOSESTYEAR	CLOSESTYEAR	CLOSESTYEAR	CLOSESTYEAR	EUMAP	EUMAP
MLT	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
NLD	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
POL	CLOSESTYEAR	CLOSESTYEAR	CLOSESTYEAR	CLOSESTYEAR	DCF	DCF	DCF	CLOSESTYEAR	CLOSESTYEAR
PRT	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
ROU	CLOSESTYEAR	DCF	DCF	DCF	DCF	DCF	DCF	CLOSESTYEAR	CLOSESTYEAR
SVK	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM	VALUE:FIRM
SVN	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
SWE	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP

Employment

The main data source for employment is the submission of data by Member States through the DCF or EU MAP. Where there are data gaps, the most recent reporting year was adjusted based on half the percentage change in real turnover (as previously described). This estimation methodology was chosen instead of other techniques based on an analysis of standard errors for the Member States where changes in employment and changes in production volume and value could be analysed. That half the percentage change in turnover is the strongest estimation of employment makes some sense as production weight can fluctuate significantly with shellfish production (particularly mussels) and also that employment has a slow and often more muted response to changes in economic performance ('employment stickiness').

For Member States that do not report total employment through the data collection framework (this includes the Netherlands), employment data from the OECD was used wherever available. For the remaining three Member States, employment was estimated by applying the ratio of real turnover (as previously described) per employee for DCF reporting Member States to the real turnover (as previously described) for the Member States without employment data.

An employment time series is also reported for FTEs. Again, the main data source is the submission of data by Member States through the DCF or EU MAP. Where there are data gaps the most recent reporting year was adjusted based on half the percentage change in real turnover (as previously described). For Member States that do not report total employment through the data collection framework, a factor of 0.6 was applied to total employment (as previously described) as calculated from those Member States reporting both total employment and FTE employment.

The following table summarises the source and/or estimation methodology for total employment:

Source	2008	2009	2010	2011	2012	2013	2014	2015	2016
AUT	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER
BEL	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER
BGR	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
CYP	DCF	DCF	DCF	DCF	DCF	DCF	DCF	ΔVALUE/2	ΔVALUE/2
CZE	OECD	OECD	OECD	OECD	OECD	OECD	OECD	OECD	OECD
DEU	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER	VALUE:WORKER
DNK	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
ESP	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
EST	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	ΔVALUE/2
FIN	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
FRA	ΔVALUE/2	ΔVALUE/2	DCF	DCF	DCF	DCF	DCF	DCF	DCF
GBR	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
GRC	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	DCF	DCF	DCF	DCF
HRV	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	DCF	DCF	DCF	DCF	DCF
HUN	OECD	OECD	OECD	OECD	OECD	OECD	OECD	OECD	OECD
IRL	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
ITA	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	ΔVALUE/2
LTU	ΔVALUE/2	ΔVALUE/2	OECD	OECD	OECD	OECD	OECD	OECD	OECD
LVA	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	EUMAP	EUMAP
MLT	DCF	DCF	DCF	DCF	DCF	DCF	DCF	ΔVALUE/2	ΔVALUE/2
NLD	OECD	OECD	OECD	OECD	OECD	OECD	OECD	OECD	OECD
POL	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	DCF	DCF	DCF	ΔVALUE/2	ΔVALUE/2
PRT	ΔVALUE/2	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
ROU	ΔVALUE/2	DCF	DCF	DCF	DCF	DCF	DCF	ΔVALUE/2	ΔVALUE/2
SVK	OECD	OECD	OECD	OECD	OECD	OECD	OECD	OECD	OECD
SVN	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
SWE	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP

The following table summarises the source and/or estimation methodology for FTEs:

Source	2008	2009	2010	2011	2012	2013	2014	2015	2016
AUT	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL
BEL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL
BGR	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
CYP	DCF	DCF	DCF	DCF	DCF	DCF	DCF	ΔVALUE/2	ΔVALUE/2
CZE	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL
DEU	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL
DNK	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
ESP	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
EST	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	ΔVALUE/2
FIN	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
FRA	ΔVALUE/2	ΔVALUE/2	DCF	DCF	DCF	DCF	DCF	DCF	DCF
GBR	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP	EUMAP
GRC	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	DCF	DCF	DCF	DCF
HRV	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	DCF	DCF	DCF	DCF	DCF
HUN	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL
IRL	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
ITA	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	ΔVALUE/2
LTU	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL
LVA	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	ΔVALUE/2	EUMAP	EUMAP
MLT	DCF	DCF	DCF	DCF	DCF	DCF	DCF	ΔVALUE/2	ΔVALUE/2
NLD	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
POL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL
PRT	ΔVALUE/2	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
ROU	ΔVALUE/2	DCF	DCF	DCF	DCF	DCF	DCF	ΔVALUE/2	ΔVALUE/2
SVK	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL	0.6TOTAL
SVN	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF
SWE	DCF	DCF	DCF	DCF	DCF	DCF	DCF	DCF	EUMAP

9 LIST OF ELECTRONIC ANNEXES

Electronic annexes are published on the meeting's web site on:
http://stecf.jrc.ec.europa.eu/web/stecf/ewg1819

List of electronic annexes documents:

EWG 18-19 – Annex 1 - Data

The economic data used to compile this report are provided in an Excel file as data tables at the following address: https://stecf.jrc.ec.europa.eu/data-reports.

10 LIST OF BACKGROUND DOCUMENTS

Background documents are published on the meeting's web site on:
http://stecf.jrc.ec.europa.eu/web/stecf/ewg1819

List of background documents:

EWG-18-19 – Doc 1 - Declarations of invited and JRC experts (see also section 7 of this report – List of participants)

KJ-AX-18-019-EN-N

STECF

The Scientific, Technical and Economic Committee for Fisheries (STECF) has been established by the European Commission. The STECF is being consulted at regular intervals on matters pertaining to the conservation and management of living aquatic resources, including biological, economic, environmental, social and technical considerations.

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Publications Office

doi:10.2760/45076

ISBN 978-92-79-79402-5